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MYCOTAXON

AN INTERNATIONAL JOURNAL FOR RESEARCH ON
TAXONOMY & NOMENCLATURE OF FUNGI, INCLUDING LICHENS

Volume LXXIV, No. 1 January-March 2000

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ISSN 0093-4666 MYXNAE 74(1): 1-256 (2000)

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Volume LXXIV(1), pp. 1-36 January-March 2000

STUDIES IN NORTH AMERICAN CORTINARII VI. NEW AND INTERESTING TAXA IN SUBGENUS PHLEGMACIUM FROM THE PACIFIC STATES OF NORTH AMERICA

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Abstract: New taxa of *Cortinarius*, subgenus *Phlegmacium*, described here include *C. cacodes, C. fraudulosus* var. *patrickensis, C. glaucocephalus, C. lilacinocolossus, C. subpurpureophyllus* var. *sulphureovelatus, C. olivaceopetasatus* and *C. atrochalybaeus*. Further information is provided for *C. spectabilis* M. M. Moser, *C. subpurpureophyllus* var. *subpurpureophyllus* Smith, *C. calyptratus* A.H.Smith and *C. ponderosus* A.H.Smith. The latter is placed in the subgenus *Phlegmacium* rather than in *Myxacium*.

Key Words: *Cortinarius, Phlegmacium,* North America, Pacific States

Introduction

In this publication we provide descriptions and information on some of the species of *Cortinarius,* subgenus *Phlegmacium*, that are found in forests from Washington state southward through Oregon into northern California. Many of theses species seem to be more common on the western or Pacific side of the Cascades and coastal mountain ranges in south western Oregon and California; however, others extend eastward into the Cascade and Klamath Mountains, for example, the eastern slopes of

Mount Hood, and the interior of northern California. Additional studies of these taxa will be necessary before more precise information on distribution and ecological parameters are known. This paper is a close companion to Moser and Ammirati (1997, 1999) and Moser (1997a, 1997b) with certain species of *Phlegmacium* in these publications overlapping ecologically and biogeographically. Together with previous papers (Moser and Ammirati, 1996; Moser et al., 1995) they form the basis for the identification of species of *Phlegmacium* in the northwestern United States. Finally these papers also help to clarify certain species or species concepts of A. H. Smith (1939, 1944).

Collecting Locations and Habitats

In the Pacific states of North America the vegetation of the Olympic and Cascade Mountains includes *Pseudotsuga menziesii-Tsuga heterophylla* forests from sea level to low elevations, and *Abies amabilis-Tsuga heterophylla* forests in montane regions, the latter often with *Abies procera* Rehder, *A. grandis* (Dougl.) Forbes, *Pseudotsuga menziesii* (Mirbel) Franco, *Pinus monticola* Dougl. and *Thuja plicata* Donn., depending on the site. At higher elevations or in more continental environments, *Pinus contorta* Dougl., *P. monticola, P. ponderosa* Dougl., *Abies lasiocarpa* (Hook.) Nutt., *A. grandis, Larix occidentalis* Nutt., *Tsuga mertensiana* (Bong.) Carr. and *Picea engelmannii* Parry may be found in various combinations along the Cascades of Oregon and Washington. *Picea sitchensis-Tsuga heterophylla* forests occur in a rather narrow band along the Pacific Coast south to northern California. These forests may occur as pure stands of *Picea*, or as mixed stands that include *Thuja plicata, Sequoia sempervirens* (D.Don.) Endl., *Myrica californica* Cham., *Pinus contorta* or *Pseudotsuga menziesii* in addition to *Tsuga heterophylla* (Raf.) Sarg.. In inland coastal areas of northern California forest can be a mixture of conifer (*Pseudotsuga menziesii)* and hardwood (*Castanopsis, Lithocarpus, Quercus, Umbellularia*). Interior mountains often have transitional vegetation at low- to mid-elevations composed of a mixture of woody plants and trees (*Pseudotsuga, Pinus, Abies, Quercus, Castanopsis, Lithocarpus, Arbutus, Arctostaphylos, Libocedrus*, etc.). depending on site and location. For more details on Oregon and Washington vegetation see Franklin and Dyrness, 1973; for California vegetation see Sawyer and Keeler-Wolf, 1995. These basic references were used in the descriptions below.

The Phlegmacia treated here come from a wide variety of forests and habitats, representing montane, lowland and coastal regions that are influenced primarily by weather patterns coming from the Pacific Ocean, with some continential influence in the more interior regions. The forests include old-growth and mature stands but in addition some areas have been previously harvested for timber. Below are brief descriptions of the collecting sites for this study.

Northern California, Outer North Coast: Sonoma County – Salt Point State Park - 20 miles north of Jenner. - Within the Redwood series; similar to Mendocino sites. **Mendocino County ,** Jackson State Forest - 2.5 miles Southeast of Fort Bragg. Casper - Little Lake Road - Collections were made near the intersection of Roads 408 and 409 (Casper - Little Lake Roads). These sites are dominated by *Lithocarpus densiflora* (Hook. & Arn.) Rehd. mixed with *Sequoia sempervirens* (D.Don.)Endl. and some *Tsuga heterophylla* and *Pseudotsuga menziesii.* In some areas *Pinus muricata* D.Don,, *Abies grandis* or *Arbutus menziesii* Pursh. also occur, as well as *Vaccinium* and *Rhododendron* plus other species depending on the site. At least part of this area is designated as the Redwood/Tanoak association. Russian Gulch State Park and Russian Gulch are within this same area. **Humboldt County** – Trinidad, and Patrick's Point and Richardson Grove State Parks - Sites vary from essentially pure stand of *Picea sitchensis* (Bong.) Carr. to mixtures of this species with *Sequoia sempervirens, Tsuga heterophylla* and other tree and woody plant species; with elements of the Redwood and Sitka Series depending on site and location. Richardson Grove State Park is more interior as compared to Trinidad and Patrick's Point, which are coastal. **Del Norte County** – Jedediah Smith Redwood State Park - A part of the Redwood series; *Sequoia sempervirens* and *Tsuga heterophylla* occur with *Lithocarpus densiflora, Pseudotsuga menziesii, Picea sitchensis* and other woody plants and trees depending on the site.

Northern California, Klamath Range. Del Norte County – Inland from Jedediah Smith Redwood State Park the vegetation changes going from the outer North Coast into the Klamath Range geographical region.- South Fork of the Smith River, Buck Creek Camp and Big Flat Station/ China Mine Road - In these areas both litter covered and bare soils occur; some sites, for exemple, Buck Creek Camp, are dominated by *Lithocarpus densiflora* with *Quercus* spp. and *Pseudotsuga menziesii* mixed in among *Vaccinium* and other woody plants on some sites. Near the intersection of road 426 and the road to Buck Creek Camp a pure stand of *Lithocarpus* was visited. At Big Flat Station / China Mine Road area the vegetation can be quite mixed, including *Pinus, Quercus, Lithocarpus densiflora,* *Pseudotsuga menziesii, Vaccinium , Arctostaphylos, Arbutus menziesii* and *Umbellularia californica.*- Danger point: This locality is about one mile southwest of Grassy Flat Campground on the north side of HW 199. The vegetation on this site is a mixture of *Lithocarpus densiflora, Quercus vacciniifolia* and *Q. chrysolepis,* with *Pseudotsuga menziesii, Pinus, Umbellularia californica, Arbutus menziesii* and *Arctostaphylos* on some sites. In some areas there is a dense shrub cover of *Vaccinium* and other shrubs.

California, Cascade and Klamath Ranges. Shasta County – Castle Crags State Park. Castella – The vegetation on this site is a mixture of conifers and broadleaf sclerophyll species representing the Douglas-fir series and Douglas-fir – Ponderosa Pine series. *Quercus kelloggii, Quercus garryana, Pinus ponderosa, P. lambertiana, Calocedrus, Arbutus* and a variety of other tree and woody plant species occur in this area depending on site and location.

California, Sierra Nevada, Yuba County – Bullards Bar Recreation Area - Schoolhouse Campground – This site is a mixture of trees, including *Pinus ponderosa, P. attenuata, P. lambertiana, Lithocarpus densiflora, Arbutus menziesii, Pseudotsuga menziesii* and *Arctostaphylos* spp. as well as other species, such as *Quercus*, depending on the site.

Southern Oregon, Mixed Evergreen Zone, Josephine County – Cave City (Junction) – The type of *Cortinarius ponderosus* was collected in a mixture of *Pinus ponderosa* and *Quercus* spp. Depending on site and location, this region is generally described as a mixture of needle-leaved and sclerophyllous broad-leaved trees, including the above genera in addition to *Pseudotsuga menziesii, Calocedrus, Lithcarpus densiflora, Arctostaphylos, Arbutus menziesii* and other species.

Oregon, Coast Ranges Province, Benton County - Woods Creek, Mary's Peak - The collecting area was thinned *Tsuga heterophylla* and *Pseudotsuga menziesii*; part of the *Tsuga heterophylla* zone. This is an extensive zone of vegetations throughout Oregon and Washington, and in the Coast Range is inland from the *Picea sitchensis* Zone. *Thuja plicata* may occur on moister sites while *Abies grandis, Picea sitchensis* and species of *Pinus* also may be present.

Oregon, Coastal Forest Zone, Lincoln County - Fogarty State Park - This site is on the immediate coast where a mixture of *Pinus, Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla* and *Thuja plicata* occur. It is part of the *Picea sitchensis* Zone and in moister habitats it has *Alnus, Salix, Vaccinium* and other woody plants and trees.

Oregon, *Abies grandis* Zone. Wasco County - Bear Springs and Clear Creek Crossings - These sites represent interior mixed conifer forests primarily composed of *Abies grandis, Pseudotsuga menziesii, Picea engelmannii* and *Larix occidentalis,* with *Tsuga mertensiana, Thuja plicata, Alnus* and other trees and woody species on some sites. Elements of the *Abies lasiocarpa* and *Pinus ponderosa* Zones can be found in this region as well.

Washington, Mount Rainier National Park - Ipsut Creek - The collecting area is mainly of *Tsuga heterophylla, Pseudotsuga menziesii* and *Abies amabilis*, elements of both the *Tsuga heterophylla* and *Abies amabilis* Zones. *Thuja plicata, Alnus rubra* Bong. and *Salix* occur on some sites.

Materials and Methods

For general methods of study and techniques see Moser 1993, Moser et al. 1995 and Moser and Ammirati 1996 and 1997. Description of microscopic characters were from sections mounted in 3% KOH. Spore measurements were made from deposits whenever possible (n=31-35). Abbreviations used to describe the basidiospore measures include: S = standard deviation, Q = quotient of spore length to spore width, V = approximate volume. To describe the density of the lamellae the following measurements are given: L = total number of lamellae reaching the stipe; l = number of lamellulae between two lamellae. Comparison of lamella width with the thickness of the piuleus context was made at about half the radius of the pileus. Color codes include Munsel Soil Color Charts (1975, example of notation, Mu 2.5YR2/4), Ridgway, Color Standards and Color Nomenclature (1912, example, Carob Brown (R)), A. Cailleux, Code des Couleurs des Sols (1981, example, Caill 55S), and Methuen Handbook of Color (example, 1D8). Macrochemical color reactions were made with 20 % or 30% KOH and/or NH_4OH. UV readings were made at approximately 360 nanometers. Collections of Meinhard Moser are deposited in the Herbarium of the Institut für Botanik der Universität Innsbruck (IB) and those of Joe Ammirati and Michelle T. Seidl at the University of Washington Herbarium (WTU).

Taxonomic Treatment

Section Multiformes Kühner & Romagn. ex Brandrud & Melot

Cortinarius (Phlegmacium) cacodes M.M.Mos. & Ammirati sp. nov.
Fig. 1, 2(1) Basidiospores, SEM, 11A

Pileo 60-125(-170) mm lato, primo hemisphaerico margine involuto, demum convexo usque applanato, glutinoso, coloribus mixtis, plerumque vinaceo tincto, saepe areis brunneis praedito, rarior totius brunneo, saepe disco ferrugineo vel rufo, plerumque partialiter obtecto e velo; lamellis primo pallide bubalinis, incarnato-bubalinis, dein cinereo-ochraceis, aetate ferrugineis, acie serrulato, adnatis usque emarginatis, usque ad 8 mm latis, confertis; stipite 40-85(-90) mm longo, 15-30 mm crasso, bulbo oblique marginato 20-40 mm lato, primo albido, dein pallide bubalino, aetate brunnescente in parte inferiore, juventute margine bulbi lilaceo tincto; velo universali primo lilaceo, mox brunnescente, cortina alba; carne albidula, odore fortiter tuberum Solani tuberosi et raphani, sapore miti. Sporis 8.5-11.2 x 5.3-6.2 µm, in media 10.1 x 5.6 µm, amygdaliformibus usque sublimoniformibus, verrucosis, apice glabro, basidiis 31-34 x 7.5-8 µm, tetrasporigeris, absque cystidiis, fibulis praesentibus.
Habitatio: in silvis coniferis (*Tsuga, Pseudotsuga, Abies*). Holotypus IB 91/618, Russian Gulch State Park, Mendocino, California, leg. M. Moser, 30 Nov. 1991

Pileus 60-125 (-170) mm diam, in young stages hemispheric with margin inrolled, later convex to applanate, glutinous, with rather mixed colors but mostly with some vinaceous tinge, Pale Vinaceous Drab (R), Vinaceous Drab (R), Light Vinaceous Drab (R), Brownish Drab (R), Cinnamon Drab (R), but often with some paler brownish areas or more rarely the whole surface paler brown, near Clay Color (R), even some areas darker brown, Sayal Brown (R) and disc often red-brown (Russet (R)), occasionally also the whole surface red-brown, sometimes rather dark, Caill 45R, 47S, 49S, innately fibrillose, on disc often with some patches or spots of veil remains which can discolor red-brown or paler, the very margin in young specimens grayish-whitish. **Lamellae** at first Pinkish Buff (R), later pale grayish ocher (Caill 69M to 70M, Sayal Brown (R)), with age also rust-brown, Ochraceous Tawny (R) to Tawny (R), edges eroded, adnate to emarginate, up to 8 mm wide (equaling 1/2 to 1 times the thickness of pileus context), close to crowded, L=120-150, l=1-3, 16-18/cm at margin. **Stipe** 40-85 (-90) mm long, 15-30 mm thick, the obliquely marginate bulb 20-40 mm, at first white, then pallid, Light Buff (R), Pinkish Buff (R), Cartridge Buff (R), downwards becoming brownish with

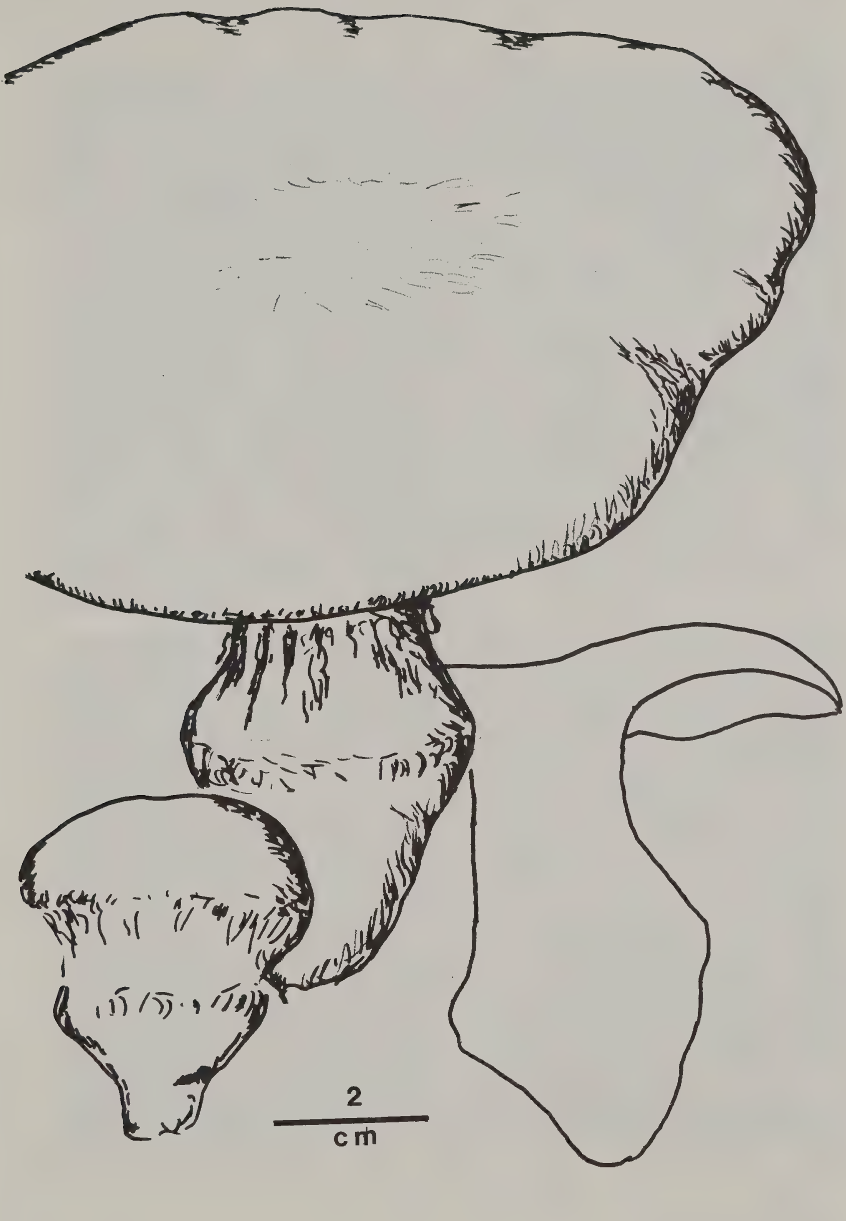

Fig. 1. *Cortinarius cacodes* (91/618) fruit bodies. (nat. size.)

age, bulb margin in young specimens with lilac tinges, later brownish. Universal veil at first lilac, but soon brownish, both on pileus and bulb margin, cortina whitish. **Context** whitish, in stipe sometimes with yellow-brownish discolored areas. **Odor** very strong of raw potatoes and radish (potato cellar). **Taste** mild.

Chemical reactions: KOH gray-brown to yellow-brown on pileus margin, red-brown on disc, in context somewhat yellowish brown (fugacious). Under **UV** bright yellow on lilac areas of pileus and outside of bulb, bluish on lamellae and stipe, pale yellowish on context.

Microscopic characters: Basidiospores 8.5-11.2 x 5.3-6.2 µm, mean 10.15 {S=0.5) x 5.6 (S=0.2) µm, Q=1.6-2, mean 1.8 (S=0.09), V=125-202, mean 167 (S=18.5), almond-shaped to sublimoniform, verrucose, apex smooth. Basidia clavate, 4-spored, 31-34 x 7.5-8 µm, some with yellow content, subhymenial hyphae 3-4.5 µm wide, trama hyphae 5-8 (-9) µm wide, in mediostratum up to 13-14 (-15) µm wide, walls pale yellowish ochraceous in KOH, clamp connections present. Cortina hyphae 2-5.5 µm wide, colorless, clamp connections present. Pileipellis with gelatinous pellicle of 2-4 mm wide, repent hyphae, walls yellowish, slightly curly, clamp connnections present, epicuticular hyphae 4-8 µm wide, walls yellow-brown, without distinct subcutis.

Habitat: Mixed conifer forests, *Tsuga, Pseudotsuga, Abies*.

Collections examined: IB 91/503, Jackson State Forest, Mendocino Co., Little Lake Rd., about 4 miles from Mendocino, leg. M. Moser, 22 Nov. 1991, IB 91/523, same area, 23 Nov. 1991; 91/542, Russian Gulch State Park, Mendocino, 25 Nov. 1991, 91/544, same area and date, 91/618, same area, 30 Nov. 1991 (holotype); 91/565, Richardson Grove State Park, Humboldt Co., 26 Nov. 1991; 95/189 Ipsut Creek, Mt. Rainier Nat. Park, Wash., leg. M. Seidl, 27 Sept 1995; 95/604 and JFA11804, Big Flat Station, South Fork Smith River, Cal., 21 Nov. 1995, 95/680, Caspar - Little Lake Rd., T17N/R17W, quadrant 8, Mendocino Co., leg. M. Moser, 7 Dec. 1995.

Variant: IB 91/718, Bullard's Bar Recreation Area, Schoolhouse Campground, Yuba Co., Calif., mixed forest of *Pinus lambertiana, P. ponderosa, P. attenuta, Lithocarpus, Arbutus, Arctostaphylos,* and *Pseudotsuga*, 9 Dec. 1991. Differs by slightly longer and morer slender basidiospores.

Comments: *Cortinarius cacodes* belongs to section *Multiformes* Kühn. & Romagn. ex Brandr. & Melot. Diagnostic characteristics are the variable colors of the pileus and the strong odor.

Section Cliduchi (Fr.) Sacc.

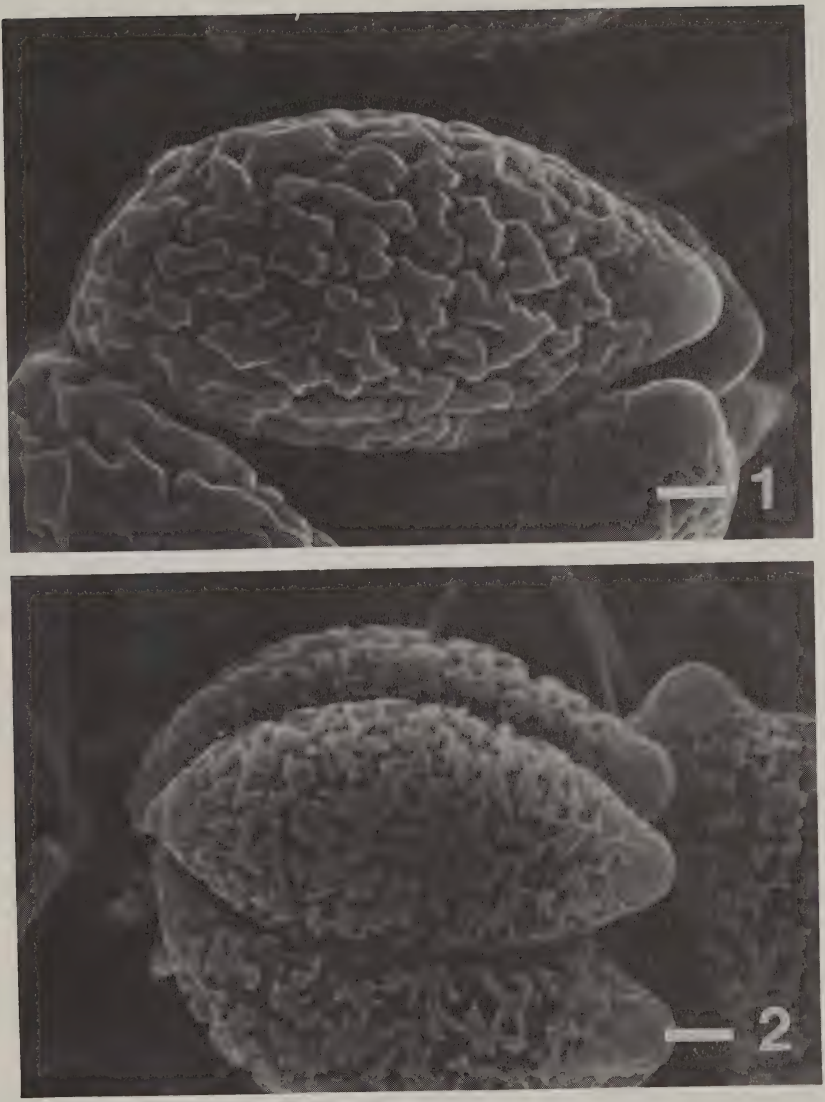

Fig. 2. Basidiospores in SEM of: 1. *Cortinarius cacodes* (91/618).
2. *Cortinarius glaucocephalus* (95/679) (x 9000).

Cortinarius* (*Phlegmacium*) *fraudulosus Britzelm. var. ***patrickensis*** M.M.Moser var. n.
Fig. 3, 11B

Differt a typo pileo magis glutinoso, pallide ochraceo, disco brunneo, saepe punctato vel subtiliter squamuloso, lamellis tenuioribus, subdistantibus, velo brunnescente, odore primo fructuoso, dein leviter terroso ut in *C. variecolore*. Sporis minoribus, 10.8-12.7(-15) x 5.9-7.1 µm, in media 11.7 x 6.5 µm, amygdaliformibus, leviter verrucosis.
Habitatio: in silvis coniferis (*Picea sitkensis, Pseudotsuga menziesii*). Holotypus IB 95/617, Patrick's Point State Park prope Trinidad, Humboldt Co., California, leg. M. Moser, 25 Nov. 1995

Pileus 25-90 mm diam, hemispheric, convex to convex-umbonate, then applanate and depressed, glutinous, colors at first pale ochraceous, near Warm Buff (R), the center brownish to brown and often densely punctate or finely squamulose, with age ochraceous and paler brownish colors mixed (finely marbled and sometimes radially streaked), general appearance Caill 65N, sometimes with paler areas near margin, Cream Buff (R), the center somewhat granulose when dry. The margin in young specimens covered and appendiculate by white veil. **Lamellae** at first between Pinkish Buff (R) and Cartridge Buff (R), later paler argillaceous, finally near Honey Yellow (R) to Clay Color (R), broadly emarginate, edges eroded, slightly ventricose, subdistant, L=40-65, l=1-3, 13-14/cm at margin, 5-12 mm wide, 2-5 times thickness of pileus context. **Stipe** 50-120 mm long, 7-15 mm thick, the somewhat clavate base 10-20 mm thick, rather rigid and hard, at first whitish, Cartridge Buff (R) to Cream Buff (R), below the white cortina fibrillose shaggy or floccose from white veil remains, the squamules attain a gray-brown color with age. **Context** whitish at first, with age brownish gray in pileus and stipe cortex, in pith paler, in base whitish. When young rather hard and compact, in pileus rather thin. **Odor** at first somewhat fruity, of green apples then slightly to strongly of green corn.

Chemical reactions. KOH 20% darker brown on pileus surface, on context in young specimens only slightly so, in older stronger gray-brown. Under **UV** lamellae yellow, context blue, pileus and stipe dark.

Microscopic characters: Basidiospores 10.8-12.7 (-15.5) x 5.9-7.1 µm, mean 11.7 (S=0.5) x 6.5 (S=0.3) µm, Q=1.6-2.0 , mean 1.8 (S=0.09), V=197-330 µm^3, mean 253 (S=30) µm^3, almond-shaped, moderately verrucose, apex smooth. Basidia 38-41 x 9-10 µm, clavate, 4-spored, subhymenial hyphae 4-5.5 µm wide, colorless, lamella trama hyphae 5-10 µm wide, colorless, clamp connections present, in mediostratum 10-12 µm wide, without cheilocystidia. Pileipellis with gelatinous layer of more

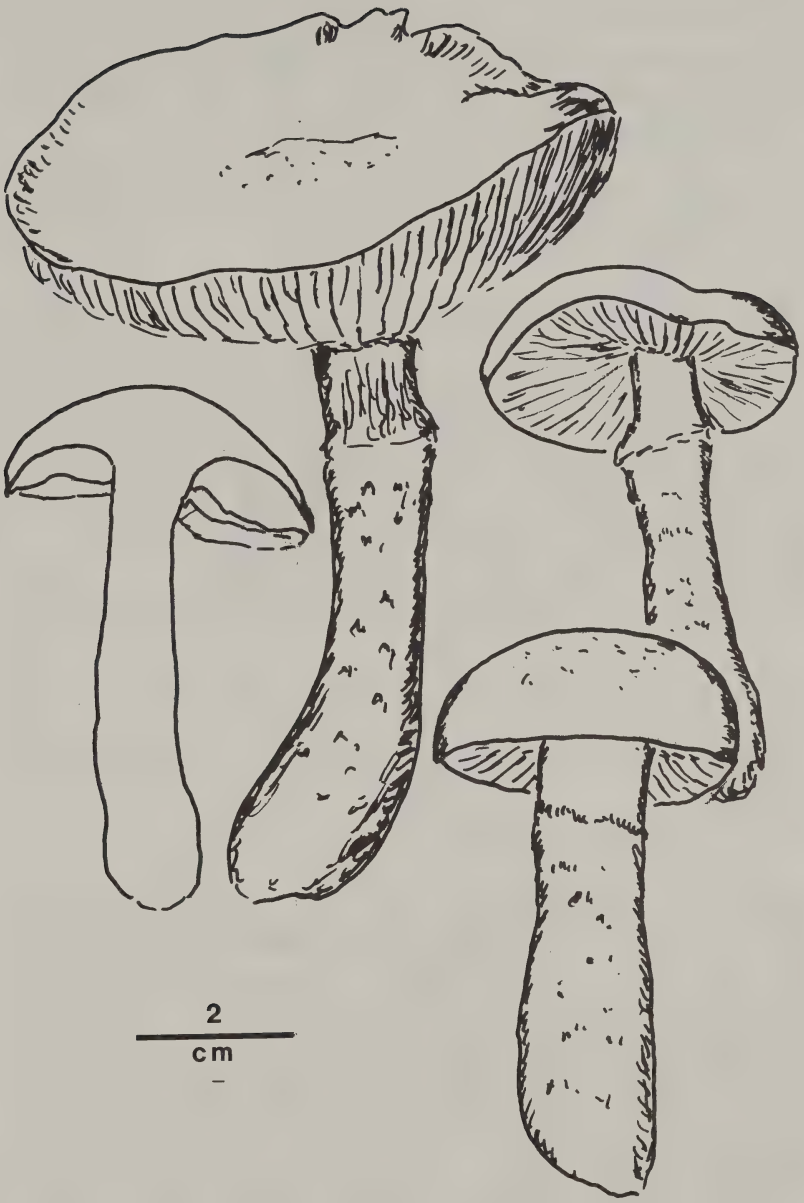

Fig. 3. *Cortinarius fraudulosus* var. *patrickensis* (95/617).
Fruit bodies (nat. size)

or less repent hyphae, 4-7 µm wide, with yellowish, partly encrusted walls, clamp connections present, epicuticular hyphae 5-9(-10) µm wide, walls yellow-brown, in subcutis hyphae subcellular, walls yellow-brown. Cortina hyphae 4-4.5 µm wide, colorless, with clamp connections, veil hyphae from stipe 6-7 µm, walls ochraceous, encrusted.

Habitat: under *Picea sitchensis* and *Pseudotsuga menziesii.*

Collections examined: IB 91/580, Patrick's Point State Park near Trinidad, Humboldt County, California, 27 Nov. 1991, leg. M. Moser; IB 95/617 (holotype), same area but another site, 25 Nov. 1995, leg. M. Moser.

Comments: This taxon resembles in many respects *C. fraudulosus* Britzelm., a species we reported from Wyoming (Moser et al. 1995). It differs, however, by a more gelatinous pileus surface, which in *C. fraudulosus* is only slightly viscid or often nearly dry even in wet conditions, brownish colors on the disc, fine squamulosity, brownish discoloring veil, thinner and less distant lamellae, the relatively thin context of pileus, the more rigid stipe and the slightly smaller basidiospores. However, it has many characters in common with *C. fraudulosus,* so we think it best to regard it as a variety of this taxon. The pileus surface resembles that of *C. papulosus* Fr., but the general color, the habit, and the size are the same as in *C. fraudulosus*.

Section Glaucopodes (Konr. & Maubl.) Brandrud & Melot

Cortinarius (*Phlegmacium*) *glaucocephalus* M. M. Moser, Ammirati & Halling sp. n.

Fig. 2(2) Basidiospores, SEM, 4, 11C.

Pileo 40-75 mm lato, primo hemisphaerico margine involuto, dein convexo usque applanato, glutinoso, primo obscure atro-veneto, dein glauco-veneto, atrocyaneo, denique glauco disco ferruginascente; lamellis primo obscure caeruleis, dein pallidioribus, griseo tinctis, subfuscis, rotundatis vel emarginatis, acie serrulato, confertis, 4-6 mm latis; stipite 30-60 mm longo, 12-19 mm crasso, bulbo marginato 17-30 mm lato, apice caesio, parte inferiore griseo-veneto, veneto, glauco, margine bulbi viridulo, demum brunneolo, velo viridulo, dein flavo-brunneo usque ferrugineo, cortina fugace; carne pilei albidula, olivaceo tincta, stipitis caeruleo variegata. Odore leniter fungino, sapore miti.
Sporis 8.2-9.4 x 4.1-5 µm, in media 8.8 x 4.7 µm, sublimoniformibus limoniformibusve, verrucosis, vertice glabro, basidiis 27-32 x 7-8 µm, tetrasporigeris, absque cheilocystidiis, fibulis praesentibus.
Habitatio: in silvis mixtis (*Tsuga, Pseudotsuga, Pinus ponderosa, Abies, Acrtostaphylos manzanitae*). Holotypus IB 95/679 Caspar Little Lake Rd.- Quadrant 8 T17N/R17W, Mendocino Co., leg. J. Ammirati & M. Moser, 7 Dec. 1995

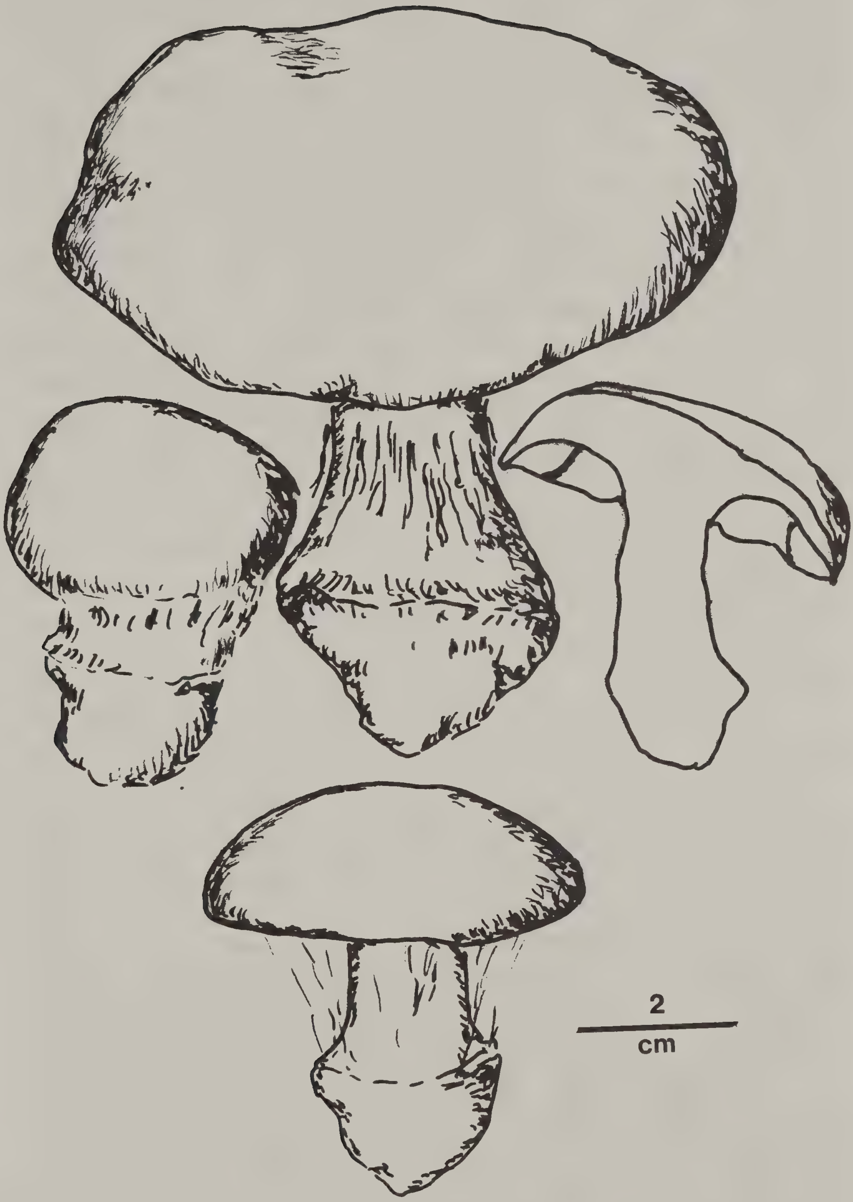

Fig.4. *Cortinarius glaucocephalus* (95/679). Fruit-bodies (nat. size).

Pileus (23-)40-75-(107) mm diam, hemispheric, then convex to applanate, glutinous, with colors dark bluish green often nearly blackish, Dark Grayish Blue-Green (R), Greenish Slate Black (R), later with more blue-green colors, American Green (R), margin in some specimens near Mignonette Green (R), Deep Lichen Green (R), disc with brownish colors, dingy red-brown, Caill 47P, to umber brown, Caill 50S, sometimes larger parts pale blue-green. **Lamellae** at first dark blue, Slate Blue (R), Dark Plumbago Blue (R), Madder Blue (R), Windsor Blue (R), later paler and mixed with gray, Drab (R), rounded adnate to emarginate, edges eroded, close, L=100, l=3, 19-20/cm at margin, 4-6 mm wide (equals 2/3 of pileus context). **Stipe** 30-60 mm long, 12-19 mm thick, the mostly narrow, marginate bulb 17-30 mm, apex grayish blue, Dutch Blue (R) to Deep Dutch Blue (R), downwards increasingly bluish green, glaucous, Glaucous Blue (R), toward the bulb more greenish, Grape Green (R), Mignonette Green (R), but much paler, silky shiny, the bulb margin at first pale greenish, soon becoming yellow- to red-brown. **Veil** at first greenish, soon yellow-brown to red-brown, cortina scanty and fugacious, on expanded basidiomata not recognizable. **Context** in pileus dingy whitish with olivaceous hue, in stipe blue, marbvled, occasionally also with slight pink hue, in bulb dingy whitish with some yellowish or yelowish brown spots and tinges. **Odor** somewhat musty, fungoid, weak, **taste** mild.

Chemical reactions: KOH 20% on pileipellis red-brown, on context dingy brown. Under **UV** pileus dull red, lamellae dark, stipe greenish yellow, context yellow (with few bluish areas).

Microscopic characters: Basidiospores 8.2-9.4 x 4.1-5 µm, mean 8.8 (S=0.3) x 4.7 (S=0.2) µm, Q= 1.7-2.2, mean 1.9, V=81-123 µm^3, mean 101 (S=9) µm^3, sublimoniform to limoniform, verrucose, apex smooth, basidia 27-32 x 7-8 µm, clavate, (2-) 4-spored, without cheilocystidia, edges with basidia and basidioles, subhymenial hyphae 3-4.5 µm wide, trama hyphae 7-12 µm wide, in mediostratum up to 15 µm wide, colorless or walls pale ochraceous in KOH, clamp connections present. Pileipellis with gelatinous layer of 4-5 µm wide, repent hyphae, walls in KOH yellow-brown, granulose encrusted, clamp connections present (slightly banded), epicuticular hyphae 5-12 µm wide, walls yellow-brown in KOH, granulose encrusted, in 12-14 µm wide, more irregular and partly subcellular hyphae.

Habitat: In mixed forests with *Tsuga, Pseudotsuga, Pinus onderosa, Abies,* and *Arctostaphylos manzanita.*

Collections examined: California: IB 91/540, Caspar Little Lake Rd., Mendocino Co., leg R. Halling, 25 Nov. 1991; IB 91/617, same area, leg. R. Halling 30 Nov. 1991; IB 95/679 (holotype) and JFA 11884, same area, T17N/R17W quadrant 8, leg.

J.Ammirati & M. Moser, 7 Dec. 1995; Oregon: IB 95/383 and JFA 11636, Bear Springs, Mt. Hood area, Wasco Co., leg. M. Moser 27 October 1995.

Comments: The species is remarkable for its rapid and strong color change. The two collections from 1991 were rather dark blue to blackish blue. Collection 95/383 from Bear Springs was of older specimens all already with bright blue-green color. Only the rich collections IB 95/679 and JFA 11884 permitted us to recognize that the collection from Oregon (95/383) actually belonges to the same species. The former collection offered all stages of development from one mycelium. The colors seem to be due to an unusual pigment. All color films do not render the blue colors, but the fungus instead appears red-brown. The taxonomic position of *C. glaucocephalus* is unclear. To judge from the colors it may be best placed in section Coerulescentes, but both the shape, size and ornamentation of the basidiospores corresponds more with that found in section Glaucopodes where we place the taxon temporarily.

Section Variecolores (Kühner & Romagn.) Brandrud & Melot

Cortinarius (Phlegmacium) lilacinocolossus M. M.Moser spec. nov.

.Fig. 5, 6(3) basidiospores, SEM, 11D

Pileo 55-210(-230) mm lato convexo, margine involuto, dein applanato, plerumque depresso, viscido, laete lilaceo, aetate coloribus ferrugineis vel rufo-brunneis immixtis praecipue discum versus sed etiam maculato marginem versus, margine diu lilaceo; lamellis jam juventute argillaceis, fumosis, nullo modo lilaceis, aetate fuscis, adnatis usque emarginatis, 5-10(-15) mm latis, acie serrulato, confertis; stipite 55-95(-130) mm longo, apice 17-53 mm, ad basim 25-62 mm crasso, subclavato usque subfusoideo, albido, parte inferiore obtecto e velo primo albido, brunnescente, saepe fasciculato; carne albida usque pallide bubalina, odore juventute dulcidulo, dein fortiter *Zeae mayidis* ut in *C. variecolore*. KOH (3%) ope reactionem luteam praebente in cuticula carneque, carne KOH 20% reactionem brunneam flavomarginatumque, NH_4OH ope laete luteam praebente. Sporis 9.4-11.5 x 5.5-6 µm, media 10.6 x 5.6 µm, subamygdaliformibus, verrucosis, vertice glabro, basidiis 37-39 x 8-9 µm, tetrasporigeris, absque cheilocystidiis, fibulis praesentibus.
Habitatio: in silvis mixtis (*Pinus lambertiana, P. ponderosa, Lithocarpus. Arbutus. Arctostaphylos, Castanopsis, Pseudotsuga*). Holotypus IB 91/707, Bullard's Bar Recreation area, Schoolhouse campground, Yuba Co., California, leg. M. Moser 9 Dec. 1991.

Pileus 55-210 (-230) mm, convex, margin involute later applanate and finally somewhat depressed, when growing in clusters also somewhat

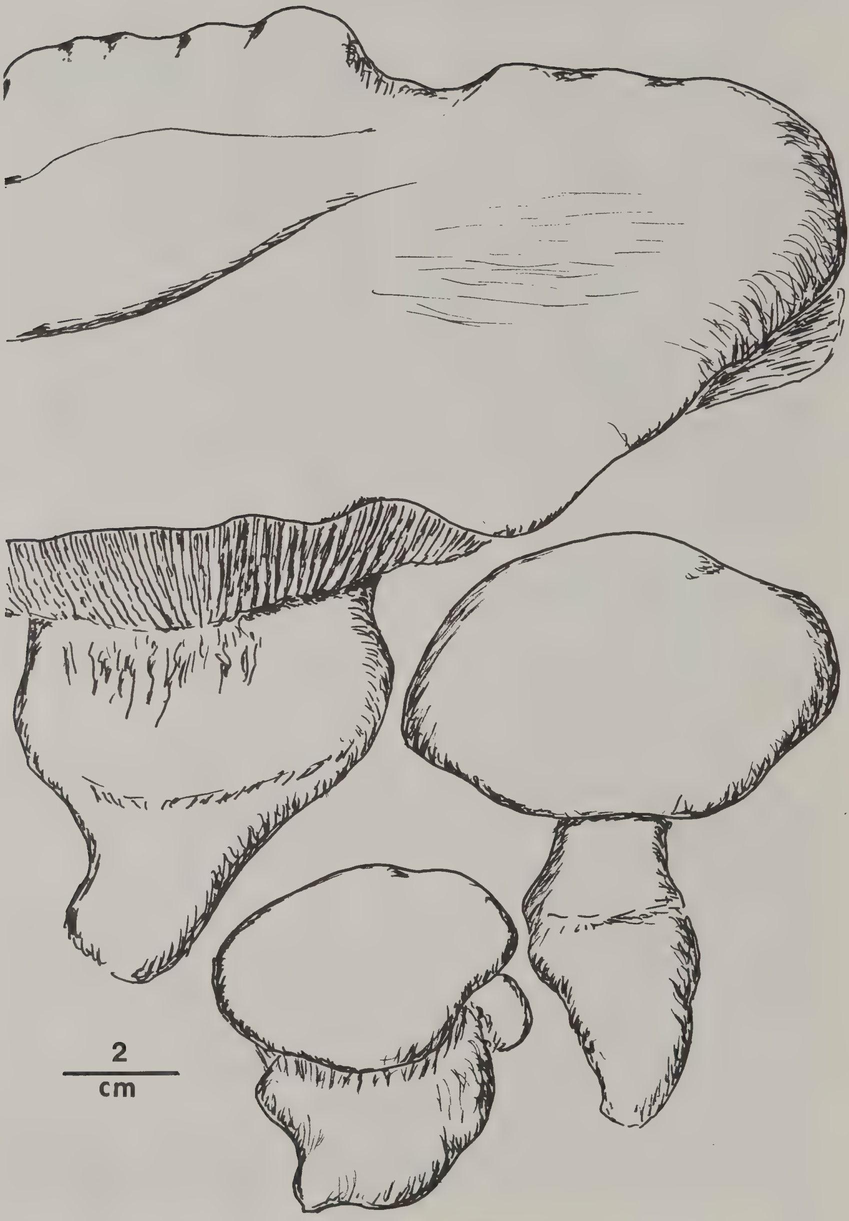

Fig. 5. *Cortinarius lilacinocolossus* (91/707). Fruit-bodies (3/4 nat. size)

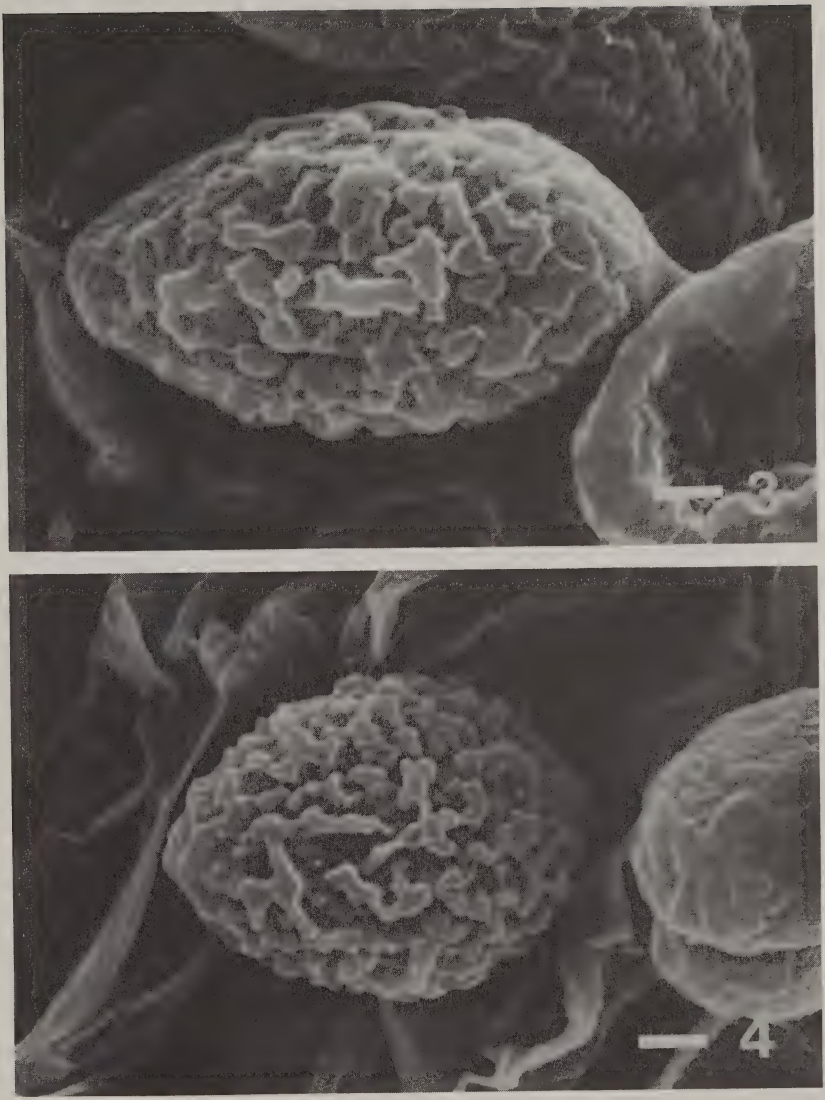

Fig. 6. Basidiospores in SEM of : 3. *Cortinarius lilacinocolossus* (91/707).
4. *Cortinarius atrochalybaeus* (95/656). (x 9000)

deformed, viscid, with bright lilac color, Deep Dull Lavender (R), Deep Vinaceous Lavender (R), then becoming mixed with different shades of reddish brown colors, Cinnamon Brown (R) or paler, Light Vinaceous Fawn (R), starting particularly from disc but also smaller or larger spots towards the margin, but margin remaining mostly lilac, Pale Anilin Lilac (R), Lavender (R), not or only slightly innately fibrillose, sometimes the disc can also fade to about Cream Buff (R). **Lamellae** already in young specimens gray-brown, argillaceous, not lilac, becoming about Wood Brown (R), adnate to emarginate, 5-10 (-15) mm broad, about 1/4 to 1/3 (-2/3) thickness of pileus context, edges eroded, close to crowded, L=100-120 (-160), l=(1-) 3-7, (11-)16-18/cm at margin. **Stipe** 55-95 (-130) mm long, above 17-53 mm thick, the base slightly enlarged or somewhat fusoid (partly due to the fasciculate growth), 25-62 mm thick, white, without any lilac tinges, lower part covered by **veil** remains which are or become pale brownish, in very young buttons white. **Context** in pileus above the lamellae up to 40 mm thick, white to whitish, Cartridge Buff (R) to Cream Buff (R). **Odor** strongly of green corn, earthy, when freshly cut somewhat grass-like, but when quite fresh also a sweetish odor can be present. **Taste** mild.

Chemical reactions. KOH 3% bright yellow on context and on pileipellis of younger specimens, with 20% KOH brown with yellow margin on context, NH_4OH bright yellow on context Under **UV** blue on pileus, stipe and context, lamellae dark.

Microscopic characters: Basidiospores 9.4-11.5 x 5.3-6 µm, mean 10.6 (S=0.5) x 5.6 (S=0.2) µm, Q=1.7-2, mean 1.9, V=138-211 μm^3, mean 174 (S=18) μm^3, narrow-amygdaliform, verrucose, apex smooth, basidia clavate to utriform, 4-spored, 37-39 x 8-9 µm, without cheilocystidia, epicuticular hyphae 4.5-8.5 µm wide, in KOH slightly yellowish, subcutis hardly differentiated, hyphae 5-8 µm wide, pileus trama of hyphae 6-15 µm wide, regular in upper part, irregular in deeper layer. Cortina hyphae 2.5-4 µm wide, clamp connections present.

Habitat: mixed forests with *Pinus lambertiana, P. ponderosa, Lithocarpus, Arbutus, Arctostaphylos, Castanopsis,* and *Pseudotsuga*. Growing in smaller to larger clusters .

Collections examined: IB 91/707, (holotype) Bullard's Bar, Recreation Area, Schoolhouse Campground, Yuba Co., California, leg. M. Moser, 9 Dec. 1991; IB 95/601 and JFA11805, South Fork Smith River, Big Flat Station, near Road toward China Mine, Del Norte Co., California, leg. M. Moser, 21 Nov. 1995.

Comments: This species is remarkable by the size which it can attain, and the fasciculate growth. It is certainly related to *C. variecolor* Fr. but differs by lack of violaceous colors both on lamellae, stipe and context.

Section Caerulescentes Rob. Henry ex Brandrud & Melot

Cortinarius (*Phlegmacium*) *atrochalybaeus* Ammirati & M.M.Moser n.sp.

Fig. 6(4), basidiospores, SEM, 7, 12L.

Pileo 30-70 mm lato, primo hemisphaerico, margine involuto, dein convexo, aetate disco applanato, margine saepe undulato, glutinoso, coloribus atrocaeruleis, margine violaceo, disco fragmentis veli obtecto; lamellis obscure griseo-lazulinis, aetate fuscis, adnatis usque plus minusve emarginatis, 4-6 mm latis, confertis; stipite 30-50 mm longo, 12-20 mm crasso, bulbo marginato 20-25 mm lato, pallide caeruleo, griseo-lazulino, bulbo fimbriato usque subvolvato e velo caeruleo; carne sordide bubalina, in cortice stipitis partialiter caeruleo marmorata; carne KOH ope reactionem brunneam, cuticula atram praebente. Sporis 7.0-8.2 x 4.7-5.4 µm, in medio 7.7 x 5.0 µm, ellipsoideis, verrucosis, basidiis 27-30 x 7-8 µm, clavatis, tetrasporigeris, absque cystidiis, fibulis praesentibus.

Habitatio in silvis frondosis (*Lithocarpus densiflora, Arbutus menziesii, Quercus vacciniifolius, Q. chrysolepis.)*

Holotypus: IB 95/630, isotypus JFA 11829 (WTU), in localita dicta „Danger Point“; Smith River Middle Fork, Del Norte Co., California, leg. J. F. Ammirati, 29. Nov. 1995

Pileus 30-70 mm diam, at first hemispheric, then convex and disc becoming applanate, margin often undulate due to the growth in fascicles, glutinous, with blackish blue color, Dark Slate Violet (R), Deep Slaty Brown (R) to Vinaceous Slate (R), or even darker, Dusky Brown (R), Dark Purplish Black (R), near margin with a narrow zone of bright violet color, Dark Plumbago Gray (R) to Ramier Blue (R), on disc with rather large patches of universal veil. **Lamellae** dark bluish gray at first, Deep Plumbago Blue (R), Dark Plumbago Blue (R), later somewhat paler, Light Plumbago Blue (R), then discoloring and becoming gray-brown, Light Drab (R), with age near Cinnamon Drab (R), rounded adnate or indistinctly emarginate, edges entire to eroded, 4-6 mm wide, equaling thickness of pileus context. **Stipe** 30-50 mm long, 12-20 mm thick, the marginate bulb 20-25 mm, pale bluish, bluish gray, Plumbago Blue (R), Lavender Gray (R), Sky Gray (R), Mineral Gray (R), the bulb fringed by bluish **veil** remains, Pale Grayish Blue-Violet (R) at first, sometimes the veil nearly submembranaceous and forming almost a volva, bulb underneath bluish to white. **Context** not violaceous or only with traces of violet in apical part of stipe, mostly dingy buff, in upper part of stipe slightly marbled with bluish gray. Without distinctive **odor. Taste** mild.

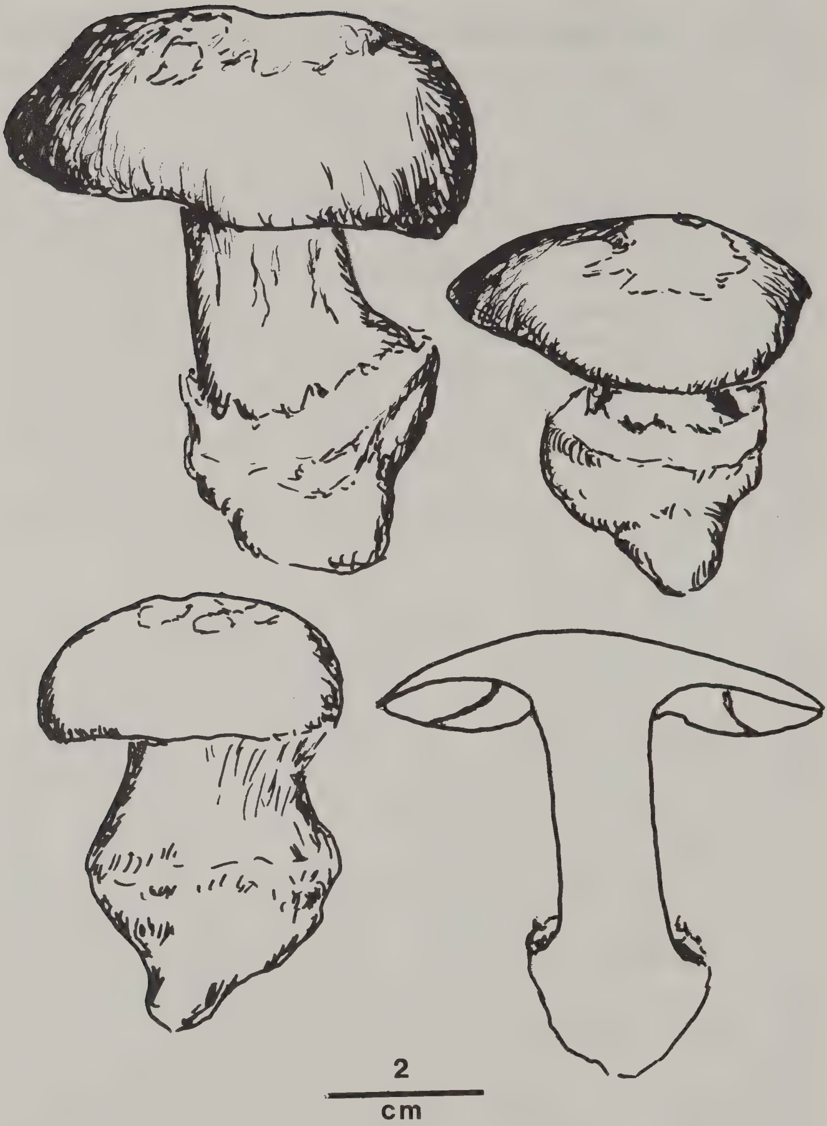

Fig. 7. *Cortinarius atrochalybaeus* (95/656). Fruit-bodies (nat. size)

Chemical reactions: KOH on context brown, on pileipellis black, Lugol negative. Under **UV** pileus dark, gills grayish, stipe yellow with some blue areas, context bluish in upper part, yellow in bulb.

Microscopic characters : Basidiospores 7.0-8.2 x 4.7-5.4 µm, mean 7.7 (S=0.27) x 5.0 (S=0.2) µm, Q=1.4-1.7 , mean 1,5 (S=0.07), V=83-116 μm^3, mean 99 (S=8.5) μm^3, elliptic, verrucose. Basidia 4-spored, clavate, 27-29 (30) x 7-8 µm, young lamella edge with cylindric to clavate sterile cells similar to or smaller in size than basidia (basidioles). Pileipellis with gelatinous surface layer of 2.5-4 µm wide, colorless, repent hyphae with clamp connections. Epicuticular hyphae 5-8 µm wide, walls ochraceous in KOH. Subcutis hyphae broad to subcellular, 12-15 (-20) µm wide, walls ochraceous in KOH, veil from "calyptra" of colorless hyphae, 4-4.5 (5) µm wide with clamp connections, from the bluish "volva" 3-5 µm wide, colorless, with clamp connections.

Habitat: under *Lithocarpus densiflora, Arbutus menziesii* and *Quercus vacciniifolia* and *Q. chrysolepis* on calcareous soil.

Collections examined: IB 95/630 and JFA11829, Danger Point, Smith River Middle Fork, Highway 199, Del Norte Co., California, 29 Nov. 1996, leg. J. F.Ammirati, IB 95/656 and JFA11860, same area but 3 Dec. 1995.

Comments: We considered at first that this fungus might be *C. calyptratus* A. H. Smith (1939). We have another collection from the South Fork of the Smith River which also had a bluish veil. The basidiospores differ significantly from those of *C. atrochalybaeus* but are similar to those of the holotype of *C. calyptratus*, both in size and shape. For comparison we give a description of this collection below under *C. calyptratus*.

Cortinarius* (*Phlegmacium*) *calyptratus A. H. Smith

Contr. Univ. Mich. Herbarium 2:14-15, 1939.
Fig. 8(5) basidiospores, SEM., 12J, 12K

Pileus 45-105 mm diam., convex applanate to depressed and margin finally upturned, glutinous, all specimens with large patches of ochraceous-whitish veil on disc, colors dark grayish violet, (R) Dark Vinaceous Gray (R), Vinaceous Slate (R), or even Violet Gray (R) with brown innate fibrills. **Lamellae** in all our specimens already discolored and brownish, Clay Color (R), Tawny Olive (R), sometimes more Wood Brown (R), only in few specimen with some lilac tint close to the stipe, rounded adnate to emarginate, edges uneven to finely eroded, close, L=80-100, l= 1-3, 15-16/ cm at margin, 8-10 mm wide (equalling thickness of pileus context). **Stipe** 60-80 x 10-20 mm, the marginate bulb 20-35 mm, bulb obliquely

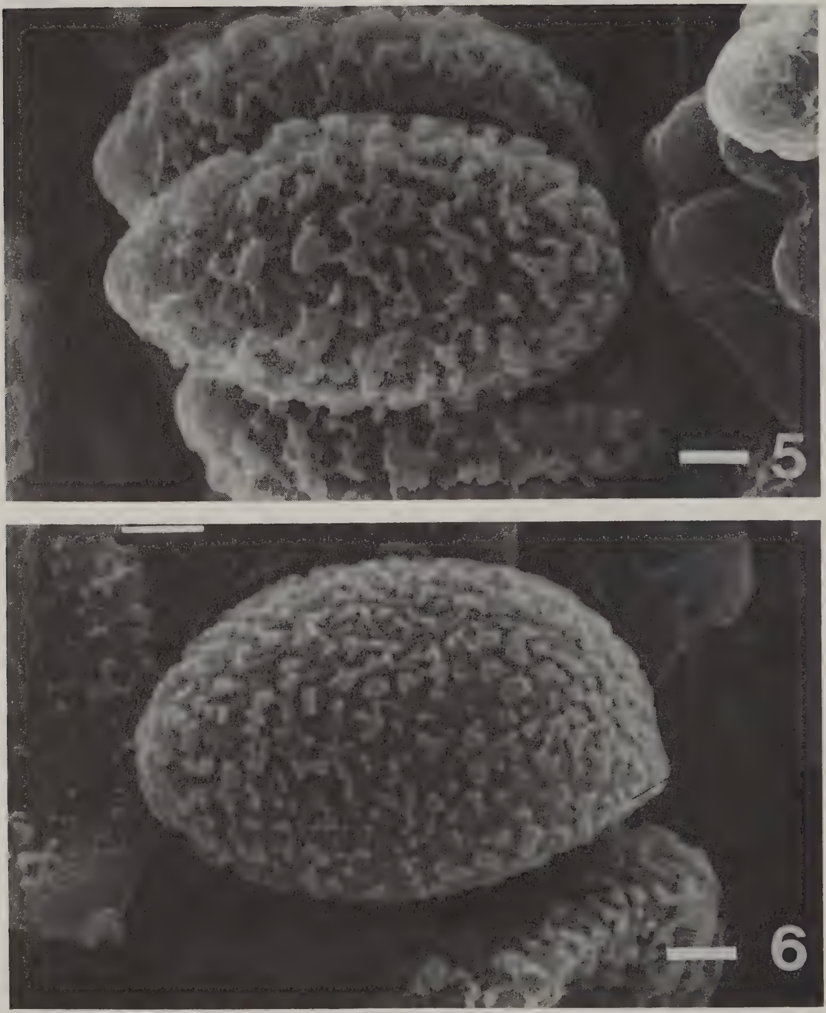

Fig. 8. Basidiospores in SEM of : 5. *Cortinarius calyptratus* (95/589) (x 9000).
6. *Cortinarius ponderosus* (JFA 11755) (x 10000)

marginate to flaring and depressed, apex in most specimens still bluish, lower half in some specimens covered by bluish-violaceous fibrills, the bulb fringed by violaceous bluish **veil**, later becoming ochraceous. **Context** bluish only in apex of stipe, otherwise buff, about Warm Buff (R). Without distinctive **odor, taste** mild.

Chemical reactions: KOH (20%) brown on pileus surface, negative on context. Under **UV** context in stipe and bulb underneath yellow, otherwise dark (negative).

Microscopic characters: Basidiospores 8.2-10 x 4.7-5.4 µm, mean 9.3 (S=0.4) x 5.1 (S=0.2) µm, Q=1.7-2.1, mean 1.8 (S=0.09), V=102-153 μm^3, mean 125 μm^3 (S=13.5), almond-shaped, some even sublimoniform, verrucose, apex smooth, Basidia 4-spored, clavate, 33-35 x 8-9 µm, subhymenial hyphae 2.3-4(-5) µm wide, lamella trama hyphae 5-8 µm wide, in mediostratum 12-14 µm wide, walls ochraceous, with rare clamp connections. Pileipellis with gelatinous pellicle of 3.4 (-4.5) µm wide, more or less repent hyphae with clamp connections, walls colorless to pale ochraceous. Epicuticular hyphae 5.5-8 µm wide, walls ocher-yellowish in KOH, subcutis hyphae 7-10 µm wide, not much differentiated. Hyphae of the calyptrate veil 2.5-4 µm, walls yellowish in KOH, clamp connections present.

Habitat: in a pure forest of *Lithocarpus densiflora* or in mixed stand of *Lithocarpus, Quercus, Pseudotsuga, Umbellularia, Arctostaphylos, Pinus*.

Collection examined: IB 95/589, Smith River South Fork, below intersection of Road 427 and road to Buck Creek Campgound, Del Norte Co., California, 19 Nov. 1995, leg. M. Moser. JFA 11789 Smith River South Fork, Big Flat Station, 19 Nov. 1995, leg. J.F. Ammirati.

Comments: Our specimens show still some lilac tints in the lamellae close to the stipe, the whole stipe is lilac and lower part covered by lilac fibrills. A.H. Smith (1939) reported this species from conifer woods (spruce and redwood) near Crescent City. However, in this area, *Lithocarpus* occurs in all forests but can be easily missed. As we collected the species in pure stands of *Lithocarpus* or mixed stands of conifer and hardwoods we think that it is most likely associated with hardwoods. The basidiospores of the type (Smith 8352) measure 7.7-9.5 x 4.7-5.3 µm, mean 8.6 (S=0.4) x 5.1 (S=0.2), Q=1.5-1.9, mean 1.7 (S=0.1), V= 97-140 μm^3 , mean 117 (=10.5) μm^3.

Section Callochroi Brandrud & Melot

Cortinarius (*Phlegmacium*) *subpurpureophyllus* A. H. Smith

Contr. Univ. Mich. Herbarium 2:17-18, 1939.
Fig. 11E,F.

Pileus 35-90 mm diam., at first hemispheric with margin involute, then convex and finally applanate and disc sometimes even slightly depressed, margin sometimes becoming wavy, marginella long remaining inrolled, very glutinous, colors mostly bright red-brown, rufous, Caill 37P, 39P, Kaiser Brown (R) or somewhat darker, margin somewhat paler, in young specimens Caill 45M, in older 45N, with pale ochraceous areas or patches of veil remains laying on the gluten, sometimes such patches up to 1-2 cm inward from margin, disc in older specimens often more dingy, not innately fibrillose. **Lamellae** at first lilac, Light Vinaceous Gray (R), Lavender (R) to Grayish Lavender (R), at maturity near Fawn Color (R), rounded adnate to slightly emarginate, edges slightly uneven to eroded, close to crowded, L= 100-130, l=1-3, 15-17/cm at margin, 4-7 (-8) mm wide, equaling thickness of pileus context. **Stipe** 60-100 mm long, 12-20 mm thick, the oblique and obtusely marginate bulb 25-35 mm, bright lilac at first down to the bulb, Light Vinaceous Gray (R), Grayish Lavender (R), particularly in the lower part of the stipe, in age, however, lilac tinges remaining at the apex, lower parts becoming dingy pallid, somewhat longitudinally striate, the veil remains at the bulb margin violaceous then whitish. **Cortina** grayish. The universal **veil** at first violaceous becoming whitish, on pileus surface becoming ochraceous. **Context** dingy whitish in pileus and bulb, lilac in upper part of stipe, often with brownish spots. **Odor** not distinctive**, taste** mild.

Chemical reactions: KOH (3%) slightly brownish on context, negative on pileipellis or only slightly darker brown, KOH 20% negative on context, dark brown on pileipellis,

Microscopic characters: Basidiospores 10-11.8 x 5.5-6.5 µm, mean 10.9 (S=0.4) x 5.9 (S=0.2) µm, Q=1.7-2.0, mean 1.8 (S=0.07), V=164-255 µm^3, mean 201 (S=20) µm^3, almond-shaped to slightly sublimoniform, verrucose, apex smooth. Basidia 4-spored, clavate, 34-36 x 10-11 µm, pileipellis with about 500 µm thick gelatinous layer of 4-5.5 µm wide hyphae, repent in basal layer, irregular in upper part, often branched, pale- to dark yellowish encrusted, encrustation sometimes in zig-zag bands, clamp connections present. Epicuticular hyphae 5.5-9 µm wide, repent, with brown encrustation, in subcutis up to 15 μm wide, less pigmented, in trama colorless, irregular to pseudoparenchymatous. Cortina hyphae 2.5-5 μm wide, colorless, clamp connections present.

Habitat. Under *Picea sitchensis, Tsuga heterophylla, Pseudotsuga menziesii.*

Collections examined: California: IB 91/568, Patrick's Point State Park near Trinidad, Humboldt Co., 27 Nov. 1991, leg. M. Moser; Smith 8164 (holotype), Crescent City, 28 Oct. 1937, Smith 8405, near Crescent City.

Comments: The collection (91/568) was rather rich and in excellent condition comprising all stages of development. It seems to agree well with the originl description. The type was collected further north near Crescent City under "spruce", meaning under *P. sitchensis.* Smith also described the adhering veil remains on the pileus. We found the basidiospores of the type collection (Smith 8164) to be 10.2-12.3 x 5.8-6.5 μm, mean 11.1 (S=0.5) x 6.1 (S=0.2) μm, Q=1.7-2, mean 1.8, V=186-270 μm^3, mean 215 (S=21) μm^3, the shape corresponds exactly to our collection. In a second collection of Smith (8405), also from Crescent City, we found the basidiospores 10.5-12 x 5.5-6 μm. Smith indicated the great similarity with *C. purpureophyllus* Kauffm. This, however is a hardwood species from Michigan. The basidiospores of the holotype are similar, slightly more sublimoniform and slightly larger: 10.9-13 x 5.9-7.3 μm, mean 11.9 (S=0.5) x 6.5 (S=0.36) μm, Q=1.56-2, mean 1.8, V=202-326 μm^3, mean 265 (S=33) μm^3. *C. parksiana* A. H. Smith, which Smith collected near Trinidad, Humboldt Co., also seems to be similar and has basidiospores of similar size but their shape is elliptic with blunt ends and distinctly different from those of *C. subpurpureophyllus.*

Cortinarius subpurpureophyllus var. sulphureovelatus M. M.Moser nov. var.

Fig. 9, 12G

Differt a typo bulbo infra mycelioque sulphureo. Habitatio:in silvis coniferis (*Tsuga heterophylla, Pseudotsuga menziesii*i. Holotypus IB 95/515, Fogarty Creek State Park, Lincoln Co., Oregon, leg. M. Moser & J. Ammirati, 10 Nov. 1995.

Pileus 40-110 mm diam, hemispheric, convex, margin involute, later applanate and slightly depressed, glutinous, bright red-brown, but somewhat paler and darker marbled, Caill 37S, 37R, 37P, margin mostly slightly paler, in young specimens Caill 45M, in older 45N, often with patches of veil remnants floating on the gluten near margin, not innately fibrillose or sometimes slightly darker finely spotted, in some young specimens the spots are larger and darker brown. **Lamellae** at first lilac, Lavender (R) to Grayish Lavender (R), but rather quickly losing this color and becoming argillaceous, with age tinged between Cinnamon Buff (R) and Sayal Brown (R), rounded adnate to emarginate, edges rather strongly eroded, serrulate, crowded, L=120-130, l=1-3, 17-19/cm at margin, 5-7 mm wide (equalling the thickness of pileus context). **Stipe** 70-150 mm long, 10-20 mm thick, the oblique, marginate bulb 25-30 mm wide, at first bright lilac first over the whole length, then discoloring and apex becoming grayish to dingy whitish, above the bulb retaining the lilac color longest, then discoloring brownish to rusty brown, the bulb underneath sulphur yellow (Sulphur Yellow (R) to Greenish Yellow (R)) and the mycelium the same color, bulb margin also with lilac and whitish colors. Young specimens are covered by yellow fibrills, the bulb margin shows also whitish to lilac fringed. **Cortina** whitish. **Context** whitish in all parts. Without distinctive odor, taste mild.

Chemical reactions: KOH (20 %) negative on context, dark brown on pileipellis. Under UV pileus dark purple, lamellae yellowish, stipe bluish (apex sometimes yellowish), bulb yellow-orange, context very faintly yellowish with few bluish areas, in general more dingy whitish.

Microscopic characters: Basidiospores 10-12.2 x 5.5-6.5 µm, mean 11.1 (S=0.5) x 6.1 (S=0.2) µm, almond-shaped to sublimoniform, some even lemon-shaped, verrucose, apex smooth. Without cheilocystidia. Basidia 34-37 x 9-10 µm, clavate, 4-spored, subhymenial hyphae 4-6 µm wide, trama hyphae 6-8 (-10) µm wide, in mediostratum 8-12 µm wide, colorless, with clamp connections. Some refringent hyphae in lamella trama. Pileipellis with gelatinous layer of more or less repent to subrepent hyphae, 3-7 µm wide, walls brown encrusted, granulose and often in garlands. Epicutis thick, hyphae 6-8 µm wide, walls brown encrusted with granules and small platelets, subcutis subcellular, walls brown encrusted.

Habitat: under *Tsuga heterophylla* and *Pseudotsuga menziesii*, *Alnus* nearby.

Collection examined: IB 95/515 (holotype) and JFA 11723, Fogarty Creek State Park, Lincoln Co., Oregon, 10 Nov. 1995, leg. M. Moser & J. F. Ammirati.

Comments: This taxon very much resembles *C. subpurpureophyllus* and the microscopic characters are the same, but it differs by the yellow color of the veil and the darker brown encrustation of the hyphae of the pileipellis. As we know several taxa both in America and Europe where the color of the veil varies between white, yellow and bluish, we think it best to regard this taxon as a variety.

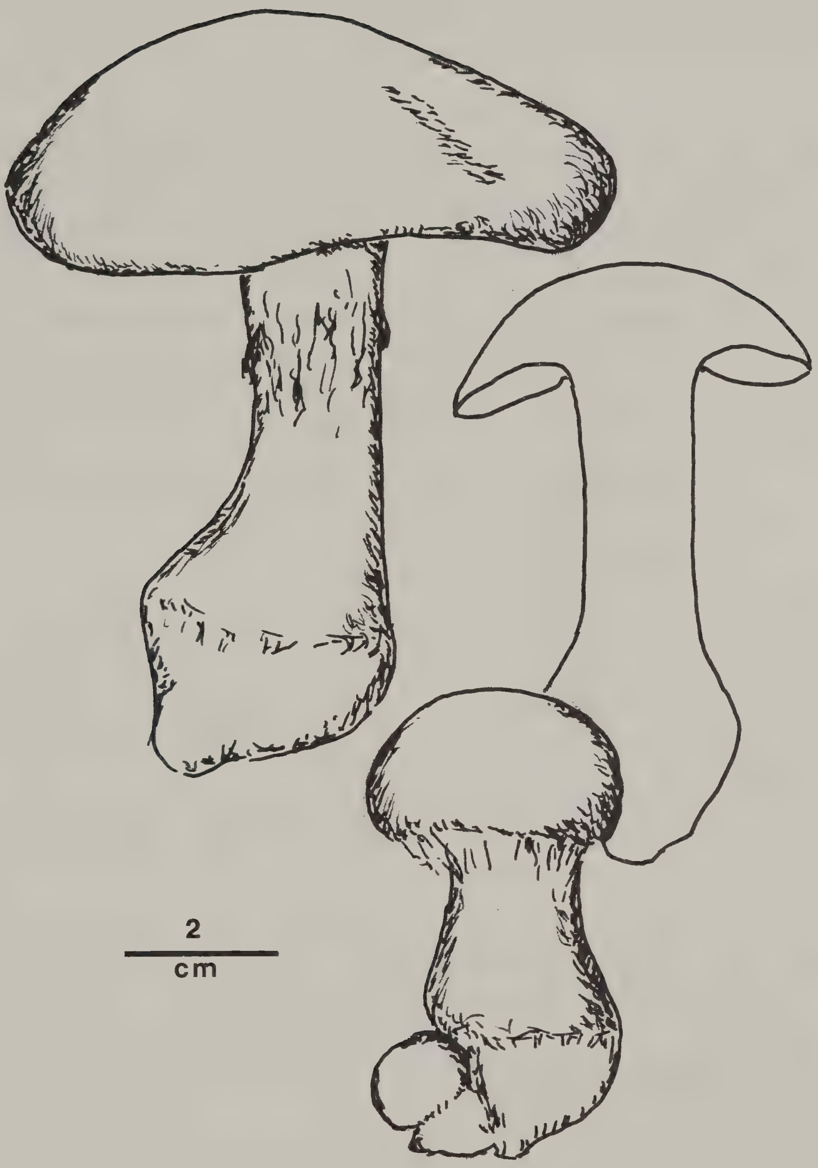

Fig. 9. *Cortinarus subpurpureophyllus* var. *sulphureovelatus* (95(515). Fruit-bodies (nat. size).

Cortinarius* (*Phlegmacium*) *spectabilis M.M.Moser
Sydowia 6:152, 1952.
Fig. 12H

Pileus 3.5-6.5 cm, convex, margin at first involute , with age only the marginella remaining so, glutinous, with pale ochraceous colors, Pinkish Buff (R) to Pale Pinkish Buff (R), disc becoming brownish with age. **Lamellae** pale lilac at first, Pale Bluish Lavender (R), emarginate, edges eroded, close to crowded, L=120, l=1-3, 18-19/cm at margin, 5-9 mm wide, equalling thickness of pileus context. **Stipe** 40-90 x 9-13 mm, with sharply marginate flaring bulb, 20-37 mm wide, pale lilac at first, later only apex retaining lilac color, downwards becoming brownish, margin of bulb slightly lilac from veil remains, later fading to whitish. **Context** lilac in apical cortex layer of stipe, otherwise whitish, in bulb also with brownish yellow areas.

Chemical reactions: KOH 20% immediately ink-red on pileus surface. Under **UV** all parts yellowish with blue areas.

Microscopic characters: Basidiospores 10.8-12.7 x 5.3-6.7 µm, mean 11.7 (S=0.46) x 6.2 (S=0.3) µm, Q= 1.7-2.3, mean 1.9, V= 181-277 μm^3, mean 238 (S=23)μm^3, almond-shaped, tapering at both ends, rugose-verrucose. Basidia 33-35 x 8-9 µm, 4-spored, clavate. Without cheilocystidia. Pileipellis with thick gelatinous layer of rather irregularly arranged, colorless hyphae 2.5-3 µm wide, with clamp connections. Epicuticular hyphae 5.5-6.5 µm wide, walls ochraceous in KOH, easily separating from trama.

Habitat: Under *Pseudotsuga menziesii* and *Larix occidentalis*.

Collection examined : IB 95/433, near Clear Creek Campground, Mt. Hood area, Wasco Co., Oregon, 31 Oct. 1995 leg. M. Moser.

Comments:: The basidiomata of this collection were somewhat smaller than in European collections (pileus 5-10 cm), but agree in colors, veil, chemical reaction and spore shape and size rather well. We considered also a possible identity with *C. metarius* Kauffm., as this species gives the same red reaction with KOH. However, it has more yellow colors and also a yellowish veil. So we excluded this possibility.

Section Fulvi Mos. & Horak

Cortinarius (*Phlegmacium*) *oliveopetasatus* M.M.Moser nov. spec.
Fig. 10, 12 I.

Pileo 60-115 mm lato, convexo margine involuto, interdum leviter crenulato, demum applanato, disco depresso, glutinoso, coloribus obscure olivaceis vel olivaceo-brunneis, disco primo plus minusve ochraceo, aetate rufo, interdum guttato, rarior innato-fibrilloso; lamellis primo argillaceis, dein flavis olivaceo tinctis, aetate ferrugineis, adnatis usque emarginatis, acie subserrulato, confertis, 5-11 mm latis; stipite 55-100 mm longo, 10-25 mm crasso, bulbo oblique marginato, 25-45 mm lato, pallide flavo, dein flavo-brunneo. Margine bulbi flavidulo vel cremeo-bubalino fimbriato; carne albida, bubalina, aetate helvola vel cerina, in cortice stipitis brunnescente, odore debile, leviter graminorum tritorum, sapore miti. Sporis 11.2-13.8-(15.3) x (5.9)-6.5-7.7 µm, medio 12.7 x 7 µm, amygdaliformibus usque sublimoniformibus, verrucosis, vertice glabro, basidiis 35-42 x 8-9 µm, tetrasporigeris, absque cheilocystidiis, fibulis praesentibus.
Habitatio: in silvis coniferis mixtis (*Abies, Picea, Pinus, Tsuga, Pseudotsuga, Larix*). Holotypus IB 95/360, prope Clear Creek Camp ground, Mt. Hood, Wasco Co., Oregon, leg. M. Moser. 25 Oct. 1995.

Pileus 60-115 mm diam., convex with margin involute, sometimes slightly crenulate, then applanate and center becoming depressed, margin undulate, glutinous, with dark olive-green to olive-brown colors, color difficult to match, close to Caill 75S, near margin Caill 77 R, disc in young specimens more ochraceous, in older ones dark red-brown, sometimes somewhat spotted, more rarely innately fibrillose, sometimes so only on the margin. **Lamellae** in young specimens argillaceous, Caill 70L to 70M, to yellow with olivaceous tinge, color difficult to match, Caill 65N, 80N, with age rusty brown, rounded behind to emarginate, edges eroded, close, l=80-100 (110), l= 1-3, 13-18/ cm at margin, 5-11 mm wide, equals 2/3 to 1 times thickness of pileus context. **Stipe** 55-100 mm long, 10-25 mm thick, the obliquely marginate bulb 25-45 mm thick, pale yellow when fresh, near Maize Yellow (R), Cream Buff (R), later yellow-brown, the bulb fringed by yellowish to cream buff **veil** remains. **Context** whitish, cream colored Cartridge Buff (R), with age the color of oxidized apple slices, in stipe cortex brownish. **Odor** weak, when cut of fresh cut grass. **Taste** mild, slightly of radish.

Chemical reactions: KOH 20% brown on pileus surface and context. **UV** pileus surface green with dark areas, later purple with green areas, lamellae dark, stipe yellow, apex bluish, context yellow with blue areas.

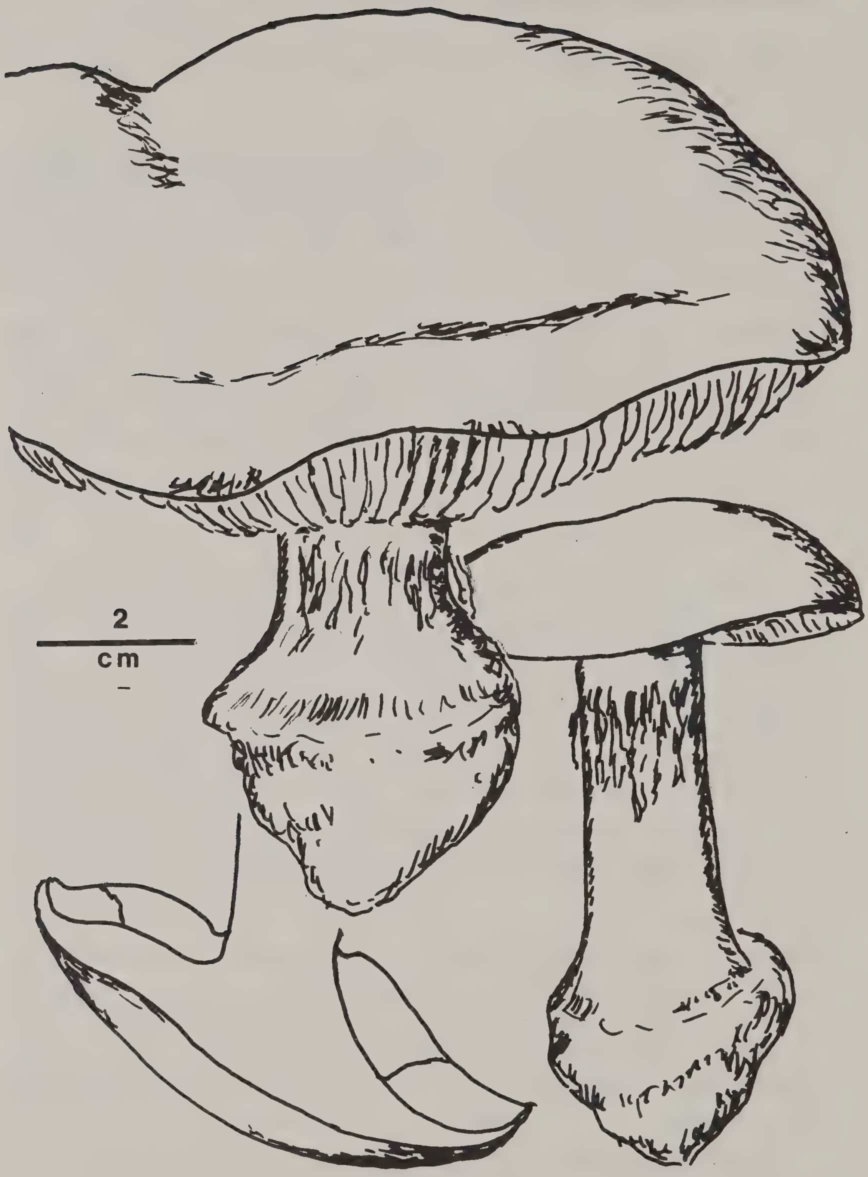

Fig. 10. *Cortinarius oliveopetasatus* (95/387). Fruit-bodies (nat. size).

Microscopic characters: Basidiospores 11.2-13.8(-15.3) x (5.9)-6.5-7.7 µm, mean 12.7 (S=0.6) x 7.0 (S=0.3) µm, Q=1.7-2.0, mean 1.85, V= 245-405 µm^3, mean 328 (S=37) µm^3, almond-shaped to sublimoniform, verrucose, apex smooth. Basidia 35-42 x 8-9 µm, clavate, 4-spored, with clamp connections. Subhymenial hyphae 4-5 µm wide, trama hyphae 6-9 µm wide, in mediostratum 12-16 µm wide. Without cheilocystidia. Pileipellis with thick gelatinous layer of hyphae 4-4.5 (5) µm wide, subrepent to irregularely ascending, colorless or walls brownish encrusted, with clamp connections. Epicuticular hyphae 6-8(-10) µm wide, in KOH with gray-brown walls, sometimes with relatively short segments.

Habitat: In mixed conifer forest (*Abies, Picea, Pinus, Tsuga, Pseudotsuga, Larix*)

Collections examined: IB 95/360 (holotype) near Clear Creek Camp Ground, Mt. Hood area, Wasco Co., Oregon, 25 Oct. 1995, leg. M. Moser, IB 95/397, same area, 28 Oct. 1995, leg. M. Moser, IB 95/390, Bear Springs, Mt. Hood area, Wasco Co., Oregon, 27 Oct. 1995, leg. M. Moser.

Comments: We have several collections of another similar unnamed taxon from the same areas. It differs, however, by more yellowish to olive colors and smaller basidiospores. But it seems closely related.

The taxonomic position of *Cortinarius ponderosus* A.H. Smith.

Contr. Univ. Mich. Herbarium 2:6-8, 1939.
Fig. 8(6) Basidiospores, SEM, 12M.

Alex Smith (1939) described this remarkable species from collections made near Cave (City) Junction in southern Oregon and near Crescent City in northern California, and placed it in subgenus *Myxacium*. In this subgenus, however, it is rather isolated with no closely related species. We have made many records and observations of this species from California and Oregon and studied its range of variability. Smith ascribed the yellowish colors on the stipe to a glutinous veil. In our collections we have not seen a glutinous stipe. Very occasionaly some slime can flow down from the pileus surface and give the appearance of a glutinous stipe. We came to the conclusion, that it is not a *Myxacium* but should be classified as a *Phlegmacium*. As there exists only the original description of the type collection we find it useful to give a description from our recent records.

Pileus in young specimens 70-120 mm diam., in older specimens 200 mm or more in size, at first hemispheric, later convex with strongly involute margin which remains so for a long time, with age applanate, and center becoming slightly depressed, moderately viscid to glutinous, slime yellowish, ground color ochraceous pallid to greenish yellow, Caill 87K to 87L, some spots more greenish, Caill 89L to 89M, but disc dingy red-brown to dark red-brown, Caill 53S, 59P, 57P, sometimes the surface with appressed brown scales and near disc confluent, toward the margin paler yellowish with olivaceous tinge, Caill 87K, 90K, with innate fibrils dissolved in spots and near the margin, where covered by plant debris the margin more or less pure greenish, Caill 87T, texture hard and compact. **Lamellae** at first gray with lilac tinge, Ecru Drab (R) to Light Drab (R), or only gray to argillaceous, Light Olive Gray (R), later changing to gray-brown, Avellaneous (R), with age Wood Brown (R), adnate, rounded behind, edges slightly eroded, narrow, 3-10 mm wide, corresponding to 1/4 to 1/2 thickness of pileus context, close, L=100-130, l= 3, 17-20/cm at margin. **Stipe** 60-150 mm long, 35-80 mm tick, equal or tapering downwards, apex whitish, ivory, occasionally with a greenish tinge, below brown, scaly or with belts and patches, similar to pileus surface, or often larger parts of the stipe totally yellow-brown, sometimes also with greenish-yellowish tints, dry or only after rain with some glutinosity due to slime dropping down from the pileus, rather hard and compact. **Cortina** white, rather strongly developed in younger specimens. **Veil** on pileus glutinous, yellow, but also the brown scales seem to be veil (?) **Context** white, whitish, to ochraceous (Ochraceous Buff (R)) in pileus, pale grayish in upper part of stipe, after exposure to air pale grayish brown, in the base of stipe slightly yellowish to buffy yellowish, in young specimens under the pileipellis occasionally also with a lilac tinge. **Odor** slightly fungoid (of *Fomitopsis marginata*) when freshly cut, or of crushed grass but mixed with some other undefined compound. **Taste** mild, or after prolonged mastication sometimes slightly bitterish.

Chemical reactions: KOH 3% on context negative, on greenish parts of the pileipellis slightly yellow-brown.

Microscopic characters: Basidiospores 7-8.8 x 4.2-5.3 µm, mean 7.9 (S=0.5) x 4.7 (S=0.2) µm, Q=1.5-1.9, mean 1.7 , V=69-120 μm^3, mean 92 (S=13) μm^3, elliptic to almond-shaped, relatively finely verrucose. Without cystidia. Basidia 29-31 x 7-7.5, clavate, 4-spored, subhymenial hyphae 2.5-3 µm wide, colorless, lamella trama hyphae 5-7 µm wide, colorless, in mediostratum up to 10-12 µm wide, clamp connections present. Pileipellis with 250-350 µm thick gelations layer of hyphae 3-4.5 µm wide, walls relatively thick, brownish, sometimes the content also brownish, in other collection colorless, repent near surface, in deeper layers more irregular and less pigmented, with clamp connections. Epicuticular hyphae 4-6(7) µm wide, walls yellow-brown to nearly colorless, without

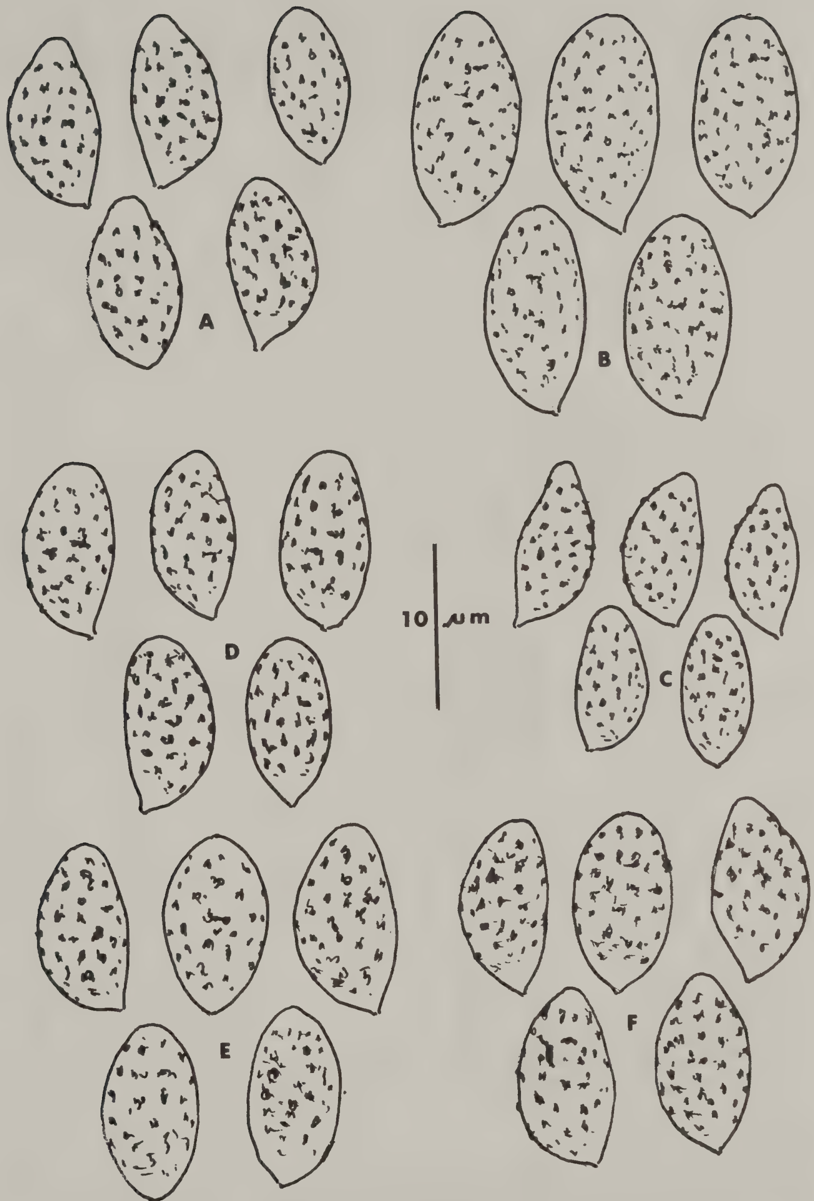

Fig. 11. Spores of : A. *Cortinarius cacodes* (91/618). B. *C. fraudulosus* var. *patrickensis* (95/617), C. *C.glaucocephalus(*95/679). D. *C.lilacinocolossus*(91/707), E.*C. subpurpureophyllus* (Smith 8164,type). F. .*C. subpurpureophyllus* (91/568) (x 2000)

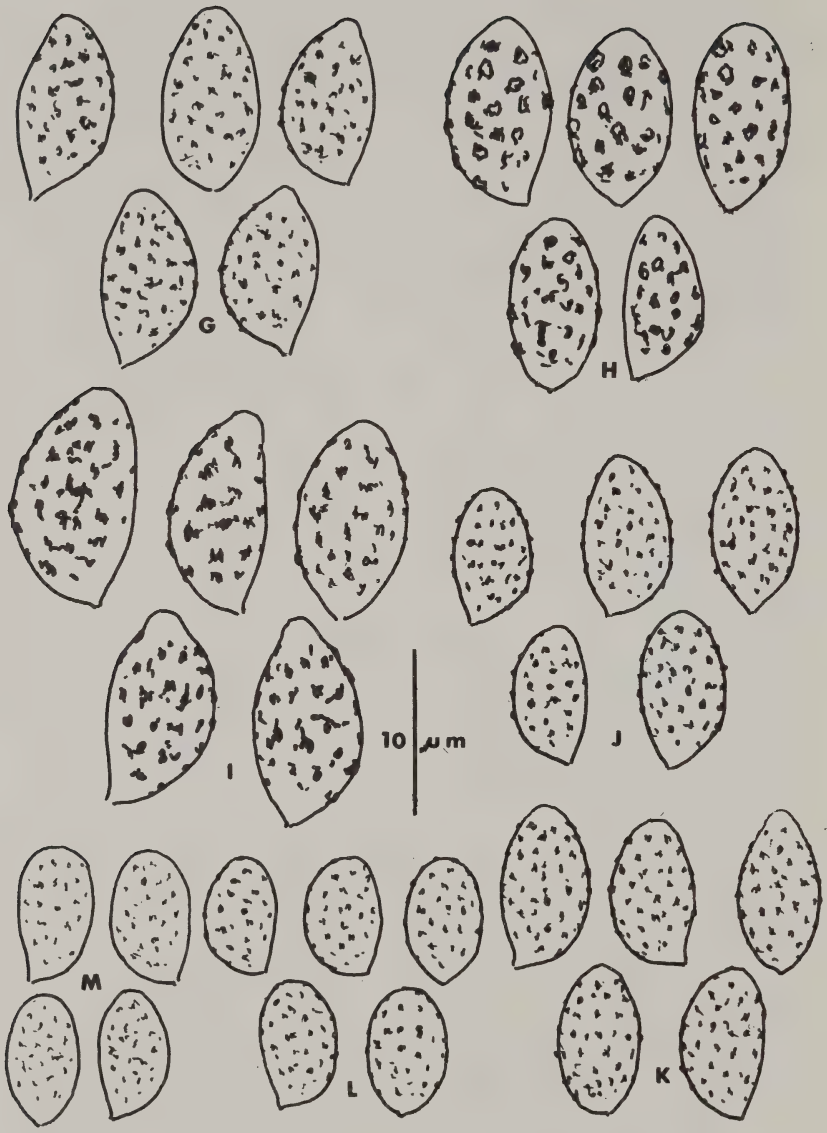

Fig. 12. Spores of: G. *Cortinarius subpurpureophyllus* var. *sulphureovelatus* (95/515). H. *C. spectabilis* (95/433). I. .*C. oliveopetasatus* (95/360). J. *C. calyptratus* (Smith 8352, type). K. *C. calyptratus* (95/360). L. *C. atrochalybaeus* (95/656). M. *C. ponderosus* (95/574) (x 2000)

distinct subcutis. Cortina hyphae 3-4 µm wide, colorless, with clamp connections. If glutinous areas are present on stipe the hyphae have the same dimensions as on pileus surface with brown, somewhat encrusted walls. Stipe cortex hyphae 4.5-6(-7) µm wide, densely packed.

Habitat: under conifers or in mixed conifer- and hardwood forests; particularly with pine species (*Pinus ponderosa, P. lambertiana*) or *Pseudotsuga* and *Tsuga.* Also, growing in mixed forests with *Pinus*, *Lithocarpus*, *Pseudotsuga*, *Quercus*, *Arctostaphylos*, *Arbutus*. Often growing in fairy rings and the basidiomata at times almost completely covered by needle litter.

Collections examined: IB91/697, Salt Point State Park, Sonoma Co., California. 7 Dec. 1991, leg. members of San Francisco Mycol. Soc., IB91/698, Bullard's Bar Recreation Area, Schoolhouse Campground, Yuba Co. California, 7 Dec. 1991, leg. D. Desjardin, IB91/709, same area but 9 Dec. 1991, leg. M. Moser, IB95/574, Jedidiah Smith State Park near Crescent City, Del Norte Co., 11 Nov. 1995 leg. M. Moser & J. F. Ammirati, MTS4334, Castle Crags State Park, Castella, Shasta County, Californis, November 28, 1996, leg. J. Ammirati; IB95/543 and JFA11755, Mary's Peak Trail, Benton Co., Oregon, 13 Nov. 1996 leg. J. F. Ammirati. (this is the northernmost locality hitherto known).

Smith collections: Smith 9273 (holotype) and Smith 8191 Cave City, Oregon, 29 Nov. 1937 Smith 9477 Crescent City, California Dec 7 1937.

Comments: Apart from the above listed collections the fungus was frequently observed in 1995 in Northern California but not collected. All collections had dry stipes and also microscopically no gelatinous layer could be demonstrated on stipe surface. So we are convinced that the species should be placed in subgenus *Phlegmacium*. But even here the taxon is rather isolated. *Cortinarius ponderosus* reminds somewhat of the mediterranean *C. herculeus* Malençon (1970). This species, however, has larger basidiospores, a green-corn odor and chemical reactions of the Variecolor-group.

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Acknowledgements

Thanks to George Mueller for preparing SEM photos and plates of basidio, to Michelle T. Seidl for collections and SEM photo of basidio, and to the D. E. Stuntz Memorial Foundation for support during this project. The senior author wants to thank Dr. Harry D.Thiers for a generous invitation for collecting excursions in California in 1991. We appreciate the use of specimens and facilities at the University of Michigan Herbarium. We thank Prof. Dr.E. Horak and Prof. Dr.H. Clemençon for reading and improving the manuscript.

MYCOTAXON

Volume LXXIV(1), pp. 37-43 January-March 2000

ON *HYPHODONTIA AUSTRALIS* (CORTICIACEAE, BASIDIOMYCOTA)

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Abstract

Hyphodontia australis is recorded and described from the *Nothofagus* forests of southern Argentina and from New Zealand. The species, previously known from Australia, is an odontioid to hydnoid taxon with orange to chestnut colored hymenial surface that readily turns violet upon the application of a drop of KOH solution. Specimens of *H. australis* from different areas are similar in all features except the spores, that vary from ellipsoid (Australian material including the type), broadly ellipsoid (New Zealand collections), to narrowly ellipsoid or subcylindric (Argentinian specimens). The inclusion of this taxon in *Hyphodontia* is supported by the presence of imperforate parenthesomes, hyphodontioid hyphae, basidia, leptocystidia, and by cultural features.

Key Words: Aphyllophorales, cultural characters, *Hyphodontia*, parenthesomes.

Introduction

During a survey of Corticiaceae *sensu lato* growing on *Nothofagus* spp. (Greslebin and Rajchenberg, 1997a, 1997b, 1998) in the subantarctic, southern forests of Argentina (Cabrera and Willink, 1980), we found the taxon *Hyphodontia australis* (Berk.) Hjortstam. This species was previously known only from Australia and has a particular hymenial surface colouration which, in addition, turns violet with drops of 5% KOH solution. The review of material housed at PDD herbarium also showed that the species is fairly well represented im New Zealand. The purpose of this work is to present full basidiocarp and cultural descriptions of *H. australis*, including the type of parenthesomes.

Materials and methods

Freehand sections of both fresh and dried basidiomata were examined microscopically, mounted in 5% KOH and 1% aqueous phloxine, Melzer's reagent (reaction amyloid, dextrinoid or IKI-; Hawksworth *et al.*, 1995), lactophenol 0.1% cotton blue and 1% aqueous cresyl-blue. Color descriptions were taken from Munsell (1990) and herbarium designations from Holmgren *et al.* (1990). Cultures were obtained from context tissue of fresh basidiomata or isolated from the associated wood-rot, and are kept at the culture collection of the Centro Forestal CIEFAP. Cultural features were studied and described according to Nobles (1965). The species code describing the cultures follows the system of Nobles (1965) with the several modifications summarized by Nakasone (1990). Line drawings of microscopic features were made using a drawing tube on the microscope. Unless other wise indicated all specimens are kept at the Herbarium of the Centro Forestal CIEFAP.

For electron microscope studies a small inoculum of culture CIEFAP Nº 226 was grown in liquid media; the growing hyphae were fixed in 2.5% glutaraldehyde buffered with sodium cacodylate and postfixed in 1% osmium tetroxide, stained in 0.5% uranylacetate, dehydrated and embedded in Spurr's low viscosity resin. Serial sections were made and stained with uranylacetate and lead citrate. Photographs were taken on a Jeol CX-II electron microscope.

Results

Hyphodontia australis (Berk.) Hjortstam, Mycotaxon 54: 187, 1995.
FIGS. 1-13
≡ *Grandinia australis* Berk., in Hooker's Bot. Antarct. Voy. Fl. Tasm. 2: 257, 1859.

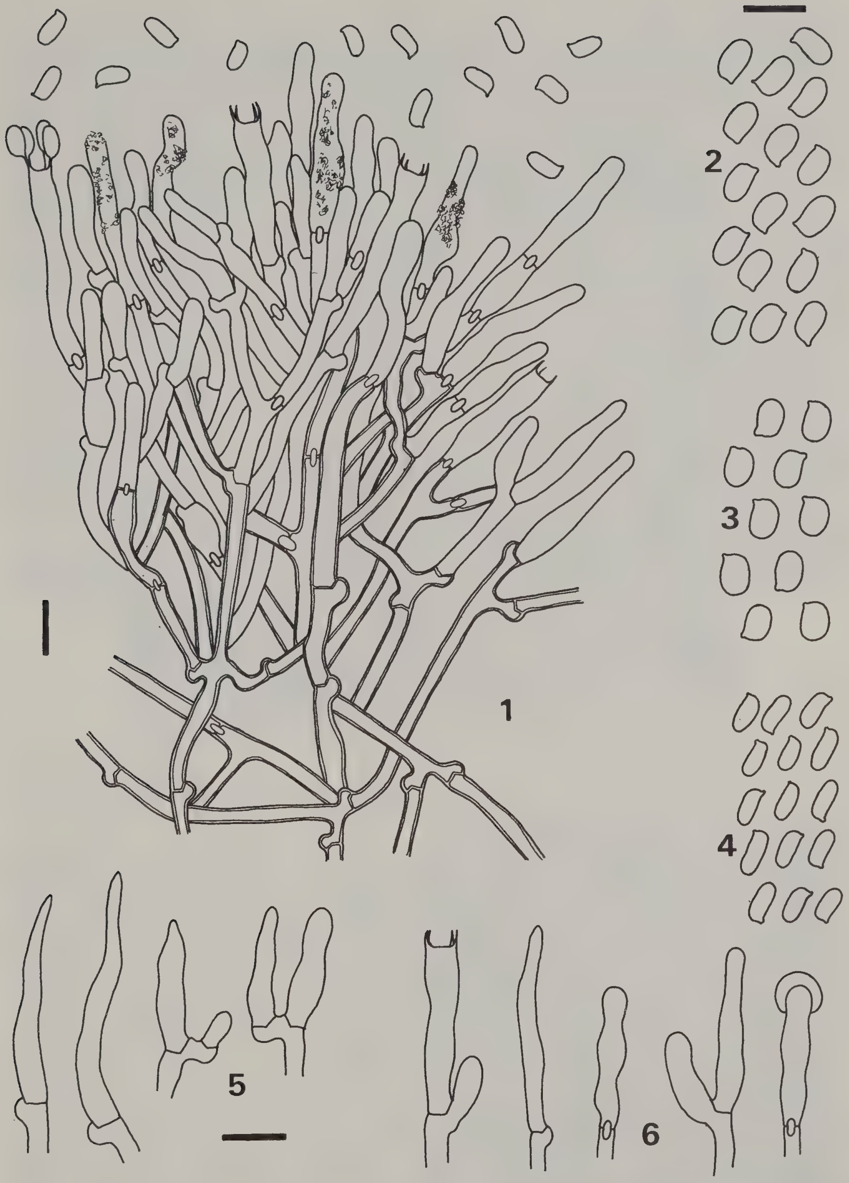
Basidiocarp resupinate, broadly effused, densely felty, 120 to 1000 µm thick. Hymenophore odontioid or hydnoid, sometimes cracking in small patches upon drying, teeth cylindrical, 350-750 µm long. Hymenial surface orange chestnut, red chestnut to light brick red (10R 6/6, 2.5YR 6/6), turning violet in KOH solution, the original color being recovered upon the application of an acid solution. Margin brownish yellow (10YR 6/6), thinning out. Subiculum concolorous with the margin.

Hyphal system monomitic. Generative hyphae clamped, 3-5 µm in diam. Subhymenial hyphae with slightly thickened walls (up to 0.5 µm thick), occasionally thin-walled. Subicular hyphae with walls up to 1 µm thick. All hyphae are covered with fine, dark melleous to chestnut granular material, which colours the hymenium and subiculum and dissolves to turn violet in KOH solution.

Basidia narrowly clavate, subcylindric or slightly sinuous, with 4 sterigmata and a basal clamp.

Leptocystidia poorly differentiated, claviform, slightly moniliform, slightly subulate or capitate, when capitate sometimes with an apical yellowish resinous cap, rarely protruding beyond the hymenium. The basidia, basidioles, leptocystidia and subhymenial hyphae are heavily encrusted with small, hyaline crystals that persist in KOH solution.

Basidiospores narrowly ellipsoid or subcylindric, 5-7 x 2.3-3 µm (Argentinian



Figs. 1-6. *Hyphodontia australis*. 1. Section through the hymenium. 2. Spores of Australian specimen K 56442 (Type). 3. Spores of New Zealand specimen PDD 23692. 4. Spores of Argentinian specimens AG 730 and MR 11041. 5. Leptocystidia of Australian specimen K 56446 and 56443. 6. Leptocystidia of Argentinian specimens AG 730 and 1634. Bar=10 µm.

specimens), ellipsoid, (5.5-)6-6.5(-7) x (3.5-)4-4.5 µm (Australian specimens) or broadly ellipsoid 5-6.5(-7.5) x 4-4.5 µm (New Zealand specimens); hyaline, thin-walled, IKI-, with one or several guttulae in the cytoplasm.

Ultrastructure: Dolipore septa with imperforated parenthesomes (Fig.7).

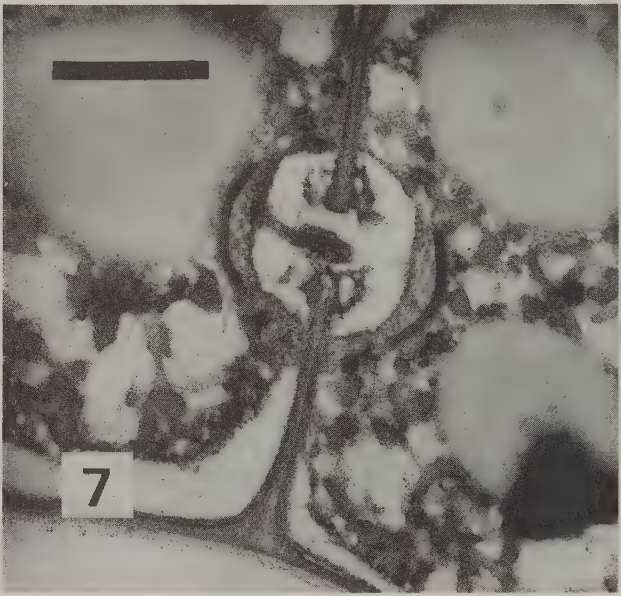


Fig. 7. *Hyphodontia australis*. Dolipore with imperforated parenthesomes. Bar=0.5 µm

Specimens examined. AUSTRALIA, TASMANIA, *ex herb. Berk. 1879* (Type of *Grandinia australis*, K 56442). Ibid., 1928, *leg. J.B. Cleland*, (K 56443). NEW SOUTH WALES, National Park, Sydney, *coll. W.N. Cheesman 1914* (K 56444). VICTORIA, Tarra Valley Park, on rotten trunk *Eucalyptus regnans* F. Muell., 22 Mar. 1956, *coll. K. Healy* (K 56446). NEW ZEALAND, COROMANDEL, Thames, Waiomo Valley, on *Coriaria arborea* Lindsay, 21 Mar. 1954, *leg. J.M. Dingley, det. G.H. Cunningham* (PDD 23692). GISBORNE Lake Waikaremoana, on *Nothofagus solandri* (Hook.) Oerst., Mar. 1949, *leg. P.M. Ambler*, *det. G.H. Cunningham* (PDD 23700). ARGENTINA, TIERRA DEL FUEGO, Ushuaia, Tolhuin, 3 km E from Hostería Kaikén, 4 Nov. 1996, *leg. A. Greslebin 730*. Ushuaia, Paso Garibaldi, on fallen branches of *Nothofagus pumilio*, 27 Mar. 1998, *leg. ipse 1547*. Ibid., 27 Mar. 1998, *leg. ipse 1548*. RÍO NEGRO, Nahuel Huapi National Park, Puerto Blest, track to Los Cántaros, on fallen branch of *Nothofagus dombeyi* (Mirb.) Oerst., 9 Oct. 1995, *leg. M. Rajchenberg 11041*. CHUBUT, Los Alerces National Park, south arm of Lago Menéndez, on fallen branch of *N. dombeyi* in mixed forest with *Fitzroya cuppresoides* (Mol.) Johnston, 8 May 1998, *leg. R.M. Borges and A. Greslebin 1634*.

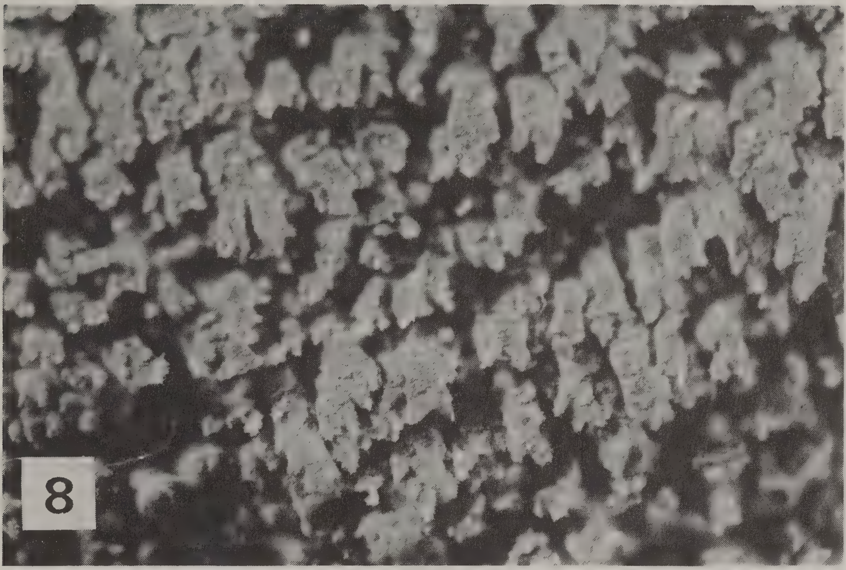


Fig. 8. *Hyphodontia australis*. Basidiocarp, collection MR 11041. 40 x.

***Culture description*.**

Cultures studied. Nº 231, from associated decayed wood of basidiocarp AG 1548; Nº 226, from associated decayed wood of basidiocarp AG 730.

Macroscopic characters. Growth very slow, 6-6.6 cm by 6 wk. Margin regular, hyaline, submerged in the agar. Colony mostly sub-merged, with only few, cobwebby hyphae present on the agar. Aerial mat only around the inoculum, appressed, subfelty, inconspicuous, white, to 1.5 cm in radius, with irregular and cobwebby margin. Reverse unchanged. Odor sweet.

Oxidase reactions.

GAA: +++, tr; TAA: +++, tr

Microscopic characters. Marginal hyphae clamped, 2-3 µm diam, thin-walled and branched. In older parts, these hyphae are wider, to 4 µm in diam, with many guttulae; developing digitiform branches

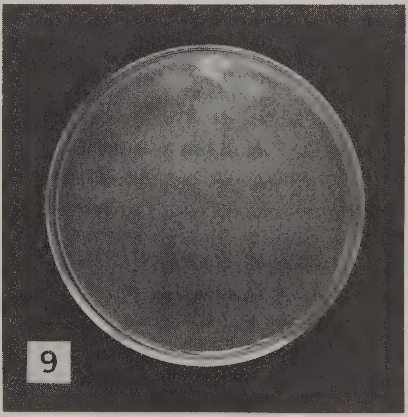
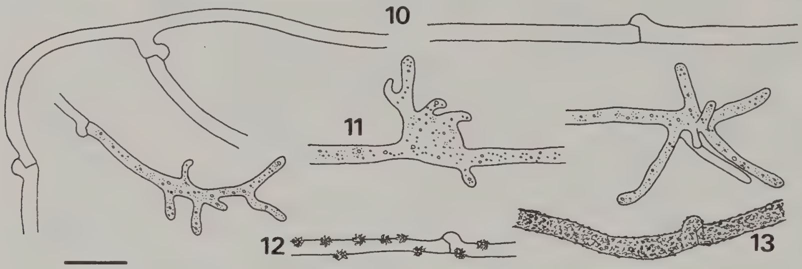


Fig. 9. Macroscopic aspect of culture at 6 wk, strain 231. Bar=2 cm.

either directly off regular hyphae or from intercalary hyphal swellings. Polyhedric, asteriform, hyaline crystals develop in the agar and on the hyphae. In older parts of the aerial mat some hyphae have a characteristic, chestnut colored encrustations that dissolves in KOH solution.

Species code. 2.3.7.32.36.(37).38.47.50.54.



Figs. 10-13. *Hyphodontia australis*. Microscopic cultural features. 10. Marginal hyphae. 11. Guttulate hyphae with digitiform branches. 12. Hyphae with hyaline polyhedric crystals. 13. Hyphae with chestnut colored granular material. Strain Nº 231. Bar=10 µm.

Discussion

Hyphodontia australis is a remarkable species within the genus because of its unusual hymenial color; all the other known species being white, cream, yellowish or ochraceous. It is also distinct by the presence of granular material on the hyphae that is responsible for the violet color change of the hymenial surface upon the application of 5% KOH solution. This reaction appears to be an acid-base reaction, as the application of an acid solution recovers the original hymenial color. This color change is recorded also in other corticioid species as *Phlebia chrysocreas* (Berk. & Curt.) Burds., *Odontia wrightii* (Berk. & Curt.) Burt, *Mycoacia uda* (Fr.) Donk, *Phanerochaete filamentosa* (Berk. & Curt.) Burdsall, *Phanerochaete radicata* (P. Henn.) Nakasone, Bergman & Burdsall and *Ceraceomyces americanus* Nakasone, Bergman & Burdsall (Cunningham, 1963; Lombard *et al*., 1975; Nakasone *et al*., 1994). In all cases it is related to the presence of dark melleous and chestnut colored substances encrusting the hyphal system. Thus, this reaction does not seem to show any phylogenetic relationsip. Most other features in *H. australis* agree with the generic concept of *Hyphodontia*, as proposed by Hjortstam (1995). In order to corroborate its inclusion in *Hyphodontia* the type of parenthesome was also studied. Langer (1994) showed that all the parenthesomes studied in species of the genus are of the imperforated type. This was corroborated on other species of the genus by Wu & Huang (1997) and is also the case in *H. australis*; thus, its inclusion in the genus is further supported by this ultrastructural feature. Hjortstam (1995) described relatively large, 40-60 µm long, subulate cystidia, but we were unable to find them in most of the specimens he examined, except K 56446 from Victoria (Australia) with leptocystidia 40-50 µm long. Cultures of *H. australis* did not develop either malocysts or drepanocysts, as is characteristic in some species of the genus (Hassan Kasim & David, 1983;

Nakasone, 1990). We observed that basidiospore shape and size were different in specimens from different areas, which may indicate a speciation process. Because we were unable to perform experimental studies to test this point and because all the other features were similar, we consider it appropiate to maintain all the specimens as a single taxon, with an austral distribution.

Acknowledgments

The Curators of PDD and K herbaria kindly provided specimens under their keeping. The critical review of the manuscript by E. Langer (Tübingen, Germany) is warmly acknowledged. The Agencia Nacional de Promoción Científica y Técnica, Argentina supported this research through PMT-PICT 0252 together with grant PIP 4062/96 from Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina. AG is fellow and MR researcher of CONICET.

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MYCOTAXON
Volume LXXIV(1), pp. 45-56 January-March 2000

NOTES ON FIVE COMMON BUT LITTLE KNOWN HIGHER BASIDIOMYCETES FROM TROPICAL YUNNAN, CHINA[1]

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Abstract

Five common but little known species in the Chinese mycoflora are reported here. *Microporellus violaceocinerascens, M. burkillii, Clitopilus crispus*, and *Lactocollybia epia* are reported for the first time for China, while *Heimiomyces tenuipes* is new to Yunnan, southwest China. Mushrooms of the genus *Lactocollybia* were not reported from China before. Interesting and important characters of these species are described and illustrated. Known distribution range for each species is given. It is suggested that *Lactocollybia cycadicola* is very closely related to *L. epia*, if they are not conspecific.

Key words *Microporellus violaceocinerascens*, *M. burkillii, Clitopilus crispus*, *Heimiomyces tenuipes*, *Lactocollybia epia*, tropical fungi, Basidiomycetes, China.

During study of macromycetes in tropical Yunnan, southwest China, we have collected specimens of five species, which are new to or little known for China. Important morphological and anatomical characters of the taxa are described and illustrated.

1. ***Microporellus violaceocinerascens*** (Petch) David & Rajch. in Mycotaxon **22:** 303, 1985. *Polyporus violaceocinerascens* Petch in Ann. Roy. Bot. Gard. Peradeniya **6:** 41, 1916.

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[1] The project supported by a grant of the Foundation for Applied Basic Researches of Yunnan Province (no. 98C026Q) and in part by a grant for Systematic and Evolutionary Biology, Chinese Academy of Sciences.

Cystostiptoporus violaceocinerascens (Petch) Ryvarden in Ryvarden & Johansen, A Preliminary Polypore Flora of East Africa, p. 301, 1980.

C. indica Dhanda & Ryvarden in Trans. Brit. Mycol. Soc. **65:** 414, 1975.

Figs. 1-3

Fruitbodies stipitate, solitary to caespitose; pileus 2.5-7 × 4-7 cm, circular, semicircular to flabelliform, sometimes depressed in center, 3-8 mm thick, coriaceous when fresh, hard on drying, dark grey brown, grey brown to yellowish brown, sometimes greyish violaceous, deeper at center, azonate to subzonate to zonate, irregularly wrinkled, pubescent, glabrescent, margin acute and often waved. Stipe 3-8 × 0.3-0.7 cm, lateral or eccentric to central, solid, subcylindrical, grey, dark grey to almost black, sometimes violaceous, pubescent, with a pseudorrhiza. Pores white to greyish white, often with violaceous tint, becoming brown when injured, greyish brown when dried, 2-3 per mm; dissepiments thin and often lacerate; tubes greyish brown, 1-5 mm long. Context cream-colored to greyish white, 1-5 mm thick, not darkening in KOH, azonate.

Hyphal system dimitic; generative hyphae 2-5(-9) μm wide, hyaline, thin-walled, with clamps at septa; skeletal hyphae 3-8 μm wide, subhyaline, thick-walled to almost solid, strongly dextrinoid; basidia 16-24 × 8-10 μm, subclavate to subcylindrical, 4-spored. Cystidia ventricose, subhyaline, thick-walled, 34-70(-120) × 13-25 μm, often incrusted at apex. Spores [130/8/7][*] (6.5-)7.0-8.5(-9.0) × (4.5-)5.0-6.5 μm [Q = (1.19-)1.24-1.55(-1.74), **Q** = 1.40 ± 0.11], often subamygdaliform, but also ovoid to ellipsoid, smooth, hyaline, slightly thick-walled, inamyloid.

Habitat: On the ground in tropical seasonal rainforests.

Specimens examined: Yunnan Prov.: Mengla County, Xishuangbanna Tropical Botanic Garden, alt. 580 m, 4. VIII. 1988, Z. L. Yang 261 (HKAS 21936); 23. VIII. 1990, Z. L. Yang 1149 (HKAS 24871); Mengla County, Menglun Nature Reserve, alt. 590 m, 12. VIII. 1988, Z. L. Yang 423 (HKAS 21937) & 424 (HKAS 21938); alt. 700 m, 20. VIII. 1988, Z. L. Yang 660 (HKAS 21939); alt. 600 m, 11. VIII. 1995, Z. L. Yang 2161 (HKAS 29495) & 2162 (HKAS 29494).

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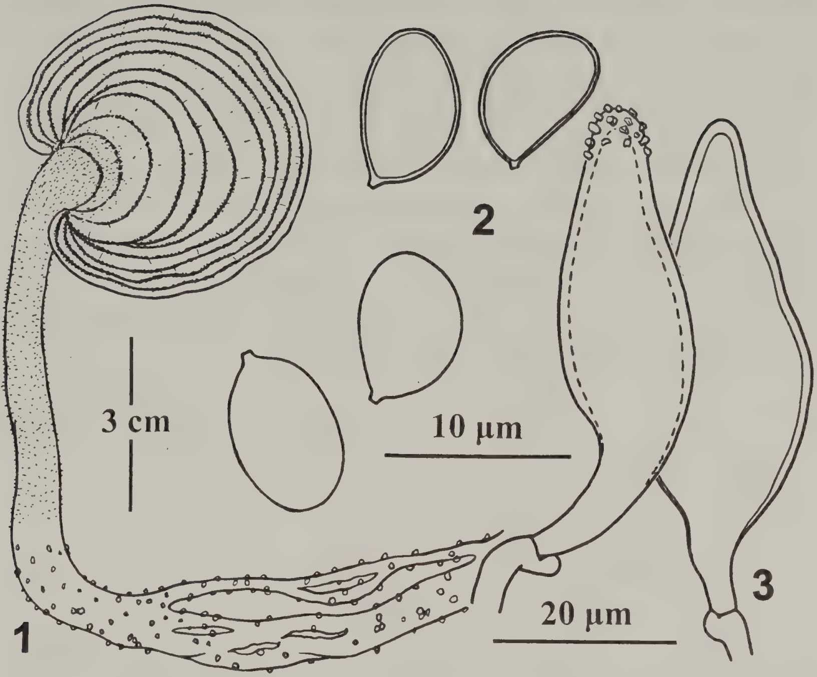
[*] 130 spores from 8 fruitbodies of 7 collections measured in 5% KOH solution, Q is used to mean "length/width ration" of a spore; **Q** means average Q of all specimens ± sample standard deviation.



Figs. 1-3: *Microporellus violaceocinerascens* (HKAS 21936). 1. basidiocarp; 2. spores; 3. pleurocystidia.

Distribution: Known from Sri Lanka, India, Pakistan, and Indonesia (Ryvarden & Dhanda, 1975; Ryvarden & Johansen, 1980; Hattori & Murakami, 1993; Suhirman & Núñez, 1998). It is new to China.

Remarks: This species is characterised by its conspicuous, often incrusted cystidia, strongly dextrinoid skeletal hyphae, and hyaline, slightly thick-walled, often subamygdaliform spores.

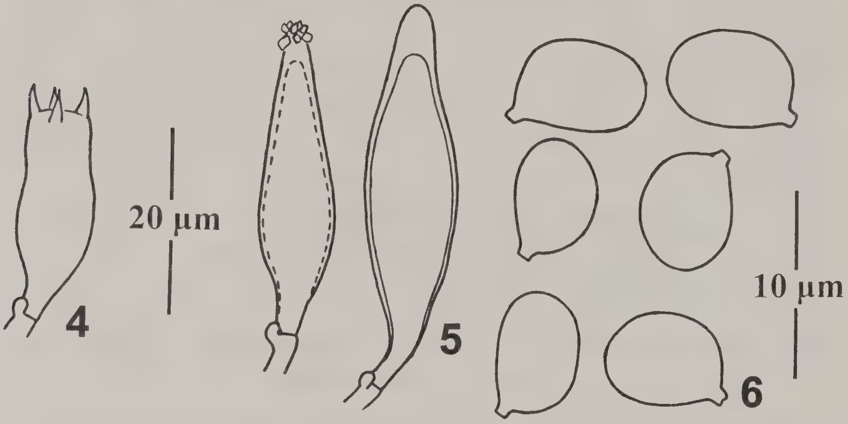
2. ***Microporellus burkillii*** (Lloyd) Corner in Beih. zur Nova Hedwigia **86:** 100, 1987.

Polyporus burkillii Lloyd, Mycol. Writ. **6:** 1061, fig. 1995, 1921.

Figs. 4-6

Fruitbodies stipitate, solitary to caespitose; pileus 5-7 × 3-5 cm, reniform to flabelliform, 2-4 mm thick, coriaceous when fresh, hard on drying, grey brown to ochraceous, zonate, irregularly to subradially wrinkled, subglabrous, margin acute and often waved. Stipe 5-6 × 0.5-0.7 cm, subcylindrical, lateral, solid, grey to dark grey, pubescent, swollen as sclerotium at the base. Pores grey, 4-6 per mm; dissepiments not lacerate; tubes greyish white, ca. 1.5 mm long. Context cream-colored to greyish white, 1-2 mm thick, not darkening in KOH, azonate.

Hyphal system dimitic; generative hyphae 2-5 µm wide, hyaline, thin-walled, with clamps at septa; skeletal hyphae 3-8 µm wide, subhyaline, thick-walled to almost solid, strongly dextrinoid; basidia 18-22 × 7.5-9 µm, subclavate to subcylindrical, 4-spored. Cystidia ventricose, subhyaline, thick-walled, 25-40 × 8-13 µm, often incrusted at apex. Spores [40/2/1] (5.0-)5.5-6.5(-7.0) × (4.0-)4.5-5.5(-6.0) µm [Q = (1.06-)1.11-1.40(-1.44), **Q** = 1.22 ± 0.09], broadly ellipsoid to ellipsoid, smooth, hyaline, slightly thick-walled, inamyloid.



Figs. 4-6: *Microporellus burkillii* (HKAS 29413). 4. basidium; 5. pleurocystidia; 6. spores.

Habitat: On the ground in tropical seasonal rainforest.

Specimen examined: Yunnan Prov.: Jinghong County, Damenglong, alt. 700 m, 14. VIII. 1995, M. Zang 12587 (HKAS 29413).

Distribution: Malaya, Singapore, Borneo (Corner, 1987). It is new to China.

Remarks: As compared to *Microporellus violaceocinerascens, M. burkillii* is characterised by its smaller pores, and broadly ellipsoid to ellipsoid, smaller spores. According to Corner (1987), *M. burkillii* is very variable. He distinguished a few varieties. Since the variation range of *M. burkillii* is not well known, we prefer not to give an infraspecific epithet for the specimen.

3. *Lactocollybia epia* (Berk. & Br.) Pegler in Kew Bull. Addit. Ser. **12:** 77, 1986.

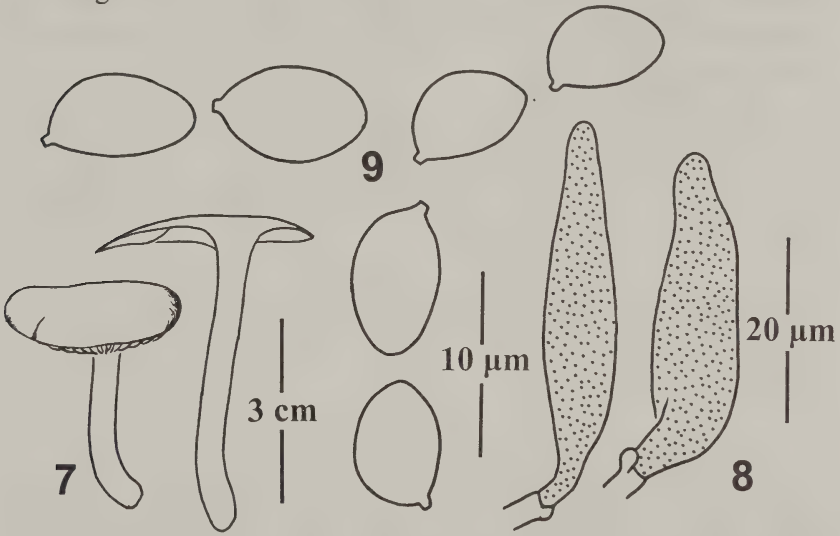
Agaricus epicus Berk. & Br. in Journ. Linn. Soc., Bot. **11:** 517, 1871.

?*Lactocollybia cycadicola* (Joss.) Singer in Schweiz. Zeitschr. f. Pilzk. **17:** 71, 1939.

Collybia cycadicola Joss. in Bull. Soc. Mycol. France **51:** 246, 1935.

Figs. 7-9

Pileus 1-3 cm in diam., convex to applanate, sometimes slightly depressed at the central part, often hygrophanous, smooth, glabrous, white to cream-colored, becoming yellow brown when dried; context thin, whitish; lamellae adnate to decurrent, close, 1-2 mm high, cream-colored, becoming brownish when dried; stipe 1-6 × 0.2-0.5 cm, subcylindrical, central to eccentric, glabrous to fibrillose, white to whitish, becoming brownish when dried.



Figs. 7-9: *Lactocollybia epia* (HKAS 24790). 7. basidiocarps; 8. pleurocystidia; 9. spores.

Spores [70/4/3] (6.0-)6.5-8.5(-9.0) × 4.0-5.5(-6.0) µm [Q = (1.30-)1.33-1.75(-2.0), **Q** = 1.52 ± 0.14], subamygdaliform, smooth, hyaline, thin-walled, inamyloid. Basidia 18-22 × 6.5-7.5 µm, clavate, 4-spored. Pleurocystidia (gloeocystidia) numerous, 30-65 × 8-18 µm, fusiform, sometimes clavate or subcylindrical, thin-walled, usually with yellow to yellow brown contents. Cheilocystidia 20-38 × 5-9 µm, subcylindrical to subfusiform, hyaline, thin-walled. All hyphae with clamp connections.

Habitat: On rotten woods of Angiospermae in tropical and southern subtropical forests.
Specimens examined: Yunnan Prov.: Mengla County, Menglun, alt. 650 m, 9. VIII. 1991, Z. L. Yang 1472 (HKAS 24789); Menghai County, near the county city, alt. 1250 m, 16. VIII. 1991, P. G. Liu 957 (HKAS 24790); Menghai County, Mangao Nature Reserve, alt. 1200 m, 16. VIII. 1991, G. Song 232 (HKAS 24518).
Distribution: pantropical (Pegler, 1986). This genus and the present species is new to China.

Remarks: *Lactocollybia epia* is characterised by the white to cream-colored fruitbodies growing on wood with numerous gloeo-elements and subamygdaliform spores. Corner (1994) provided excellent microscopic illustrations for the species.

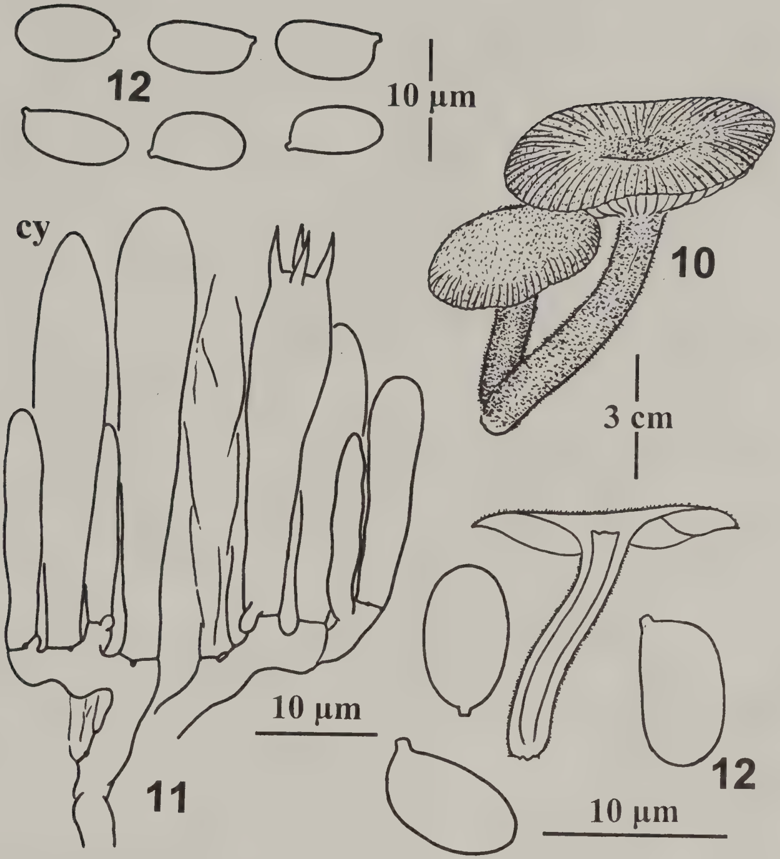
Josserand (1935) described *Collybia cycadicola* [=*Lactocollybia cycadicola* (Joss.) Singer] from France as growing on Asian cycads (*Cycas revoluta* and C. *tonkinensis*). According to his description and illustrations of the species, it is very closely related with the present species if they are not conspecific.

4. ***Heimiomyces tenuipes*** (Schwein.) Singer in Mycologia **35:** 159, 1943.
Agaricus tenuipes Schwein. in Trans. Amer. Phil. Soc. II, **4:** 147, 1822.
Heimiomyces neovelutipes (Hongo) Horak in Sydowia **32:** 148, 1979.

Figs. 10-14

Pileus 3-6 cm in diam., convex to applanate, often depressed at center, margin slightly incurved, strongly translucent-striate when wet; surface yellow to golden yellow or orange yellow, slightly darker on disc, hygrophanous, wholly villous, glabrescent; Lamellae adnexed to emarginate, yellow, 3-10 mm high, ventricose, often intervenose, distant to subdistant. Stipe 4-7 × 0.5-1 cm, central, subcylindrical, densely covered with yellow, yellow brown to gold yellow velvet, hollow.

Spores [50/2/1] (6.5-)7.0-9.5 (-10.0) × (3.5-)4.0-5.0(-5.5) µm [Q = (1.44-)1.67-2.13 (-2.5), **Q** = 1.90 ± 0.18], ellipsoid to long ellipsoid, smooth, hyaline, thin-walled, amyloid. Basidia 25-50 × 5.5-7.5 µm, clavate, 4-spored. Cheilocystidia 38-50 × 5-10 µm, with irregular, rodlike branches, with brownish, slightly thick wall. Cystidioles 35-45 × 5-7 µm,



Figs. 10-12: *Heimiomyces tenuipes* (HKAS 2322). 10. basidiocarps; 11. hymenium with basidia and a cystidiole (cy); 12. spores.

fusiform with subacute apices. Pileipellis 60-100 µm thick, composed of subradially to somewhat irregularly arranged, barrel-shaped to ellipsoid, brownish, inflated cells (35-90 × 25-55 µm) with gelatinized and refractive cell wall (2-8 µm thick); hairs on pileus (pileocystidia) often grouped into fascicles, vertically to irregularly arranged, brown, slightly thick-walled, 3-5 µm wide. Subcutis composed of subradially arranged, frequently branching, gelatinized, hyaline, filamentous hyphae, 2-5 mm wide. Trama of pileus composed of irregularly arranged ellipsoid to long ellipsoid, sometimes ovoid, hyaline, inflated cells (85-170 × 25-40 µm) with gelatinized and refractive cell wall (5-10 µm thick), mixed with

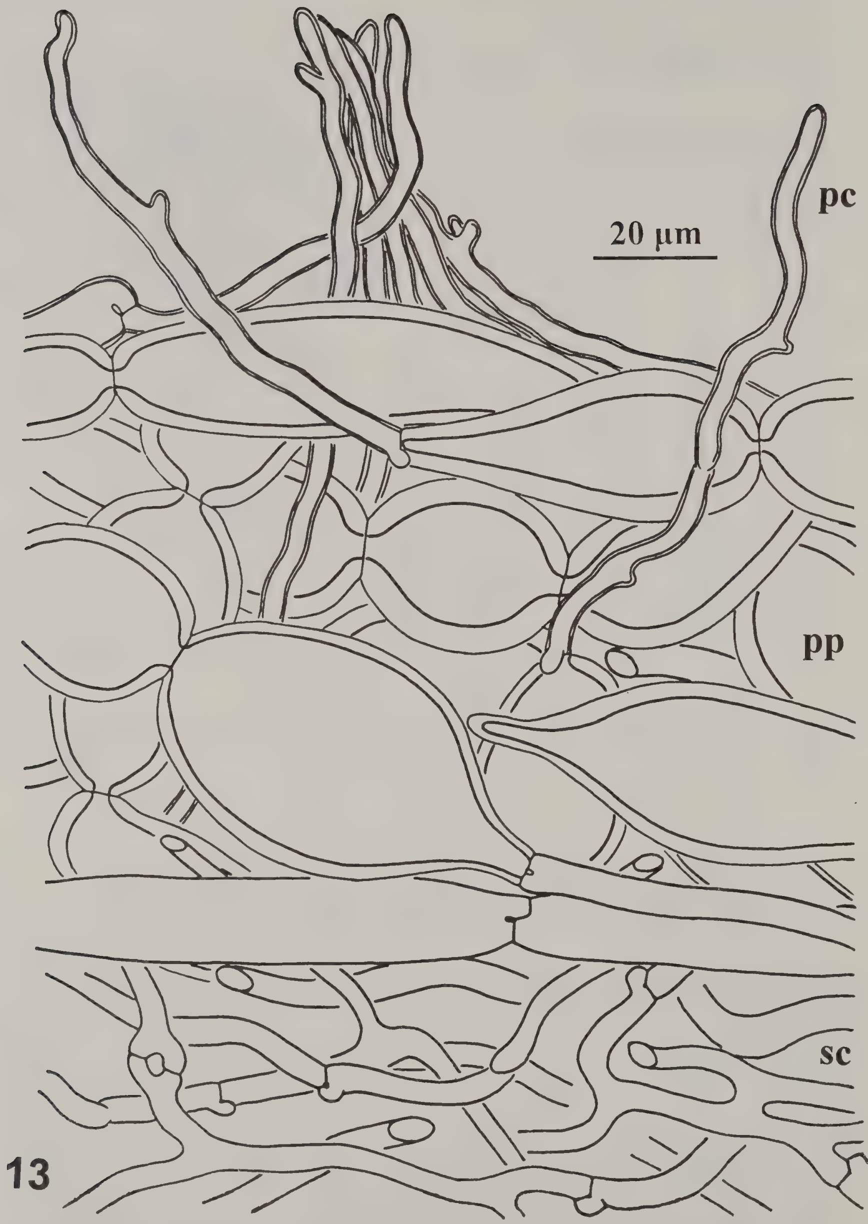

pc
20 µm
pp
sc
13

Fig. 13: Pileocystidia (pc), pileipellis (pp) and subcutis (sc) of *Heimiomyces tenuipes* (HKAS 2322).

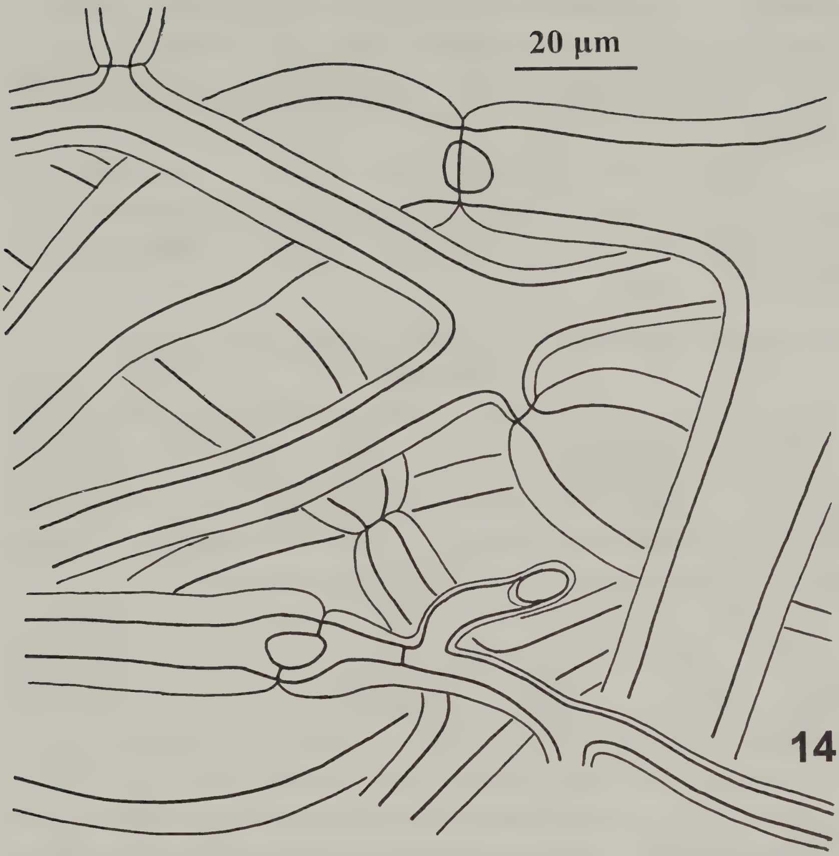


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Fig. 14: Trama of pileus of *Heimiomyces tenuipes* (HKAS 2322).

gelatinized, filamentous hyphae, 3-7 µm wide. Hairs on surface of stipe (caulocystidia) 200-700 × 3-8 µm, cylindrical, sometimes branched, with brown thick wall. All hyphae with clamps.

Habitat: On dead logs in tropical forests.
Specimen examined: Yunnan Prov.: Jinghong County, Menghan, 19. X. 1974, M. Zang 2322 (HKAS 2322).
Distribution: widely distributed in tropical regions of the world (Corner, 1996). It occurs also in North America (Miller, 1968; Redhead & Ginns, 1980). It is new to Yunnan. In China it was also reported from Fujian Prov., southeastern China (Huang, 1998).

Remarks: The appearance of the fruitbodies of *Heimiomyces tenuipes* is reminiscent of the temperate species *Flammulina velutipes* (Curt.: Fr.) Karst. from which it may be separated by the non-viscid pileus, amyloid spores, and more importantly by the different anatomical structure of the fruitbody.

Hongo (1976), and Corner (1996) consider *H. neovelutipes* as a synonym of *H. tenuipes*. Horak (1979) regards *H. neovelutipes* as an independent species. For the time being, we follow the suggestion of the former two.

5. *Clitopilus crispus* Pat. in Bull. Soc. Myc. France **29:** 214, 1913.

Figs. 15-17

Pileus 2-7 cm in diam., convex to applanate, often slightly depressed at center, white to chalk white, margin incurved, finely subfimbriate, with radially arranged fine ridges extending nearly halfway to the disc; context white; lamellae 2-3 mm high, decurrent, white to cream-colored to pinkish; stipe 2-6 × 0.3-0.8 cm, subcylindrical, central to excentric, white, smooth, sometimes finely fibrillose.

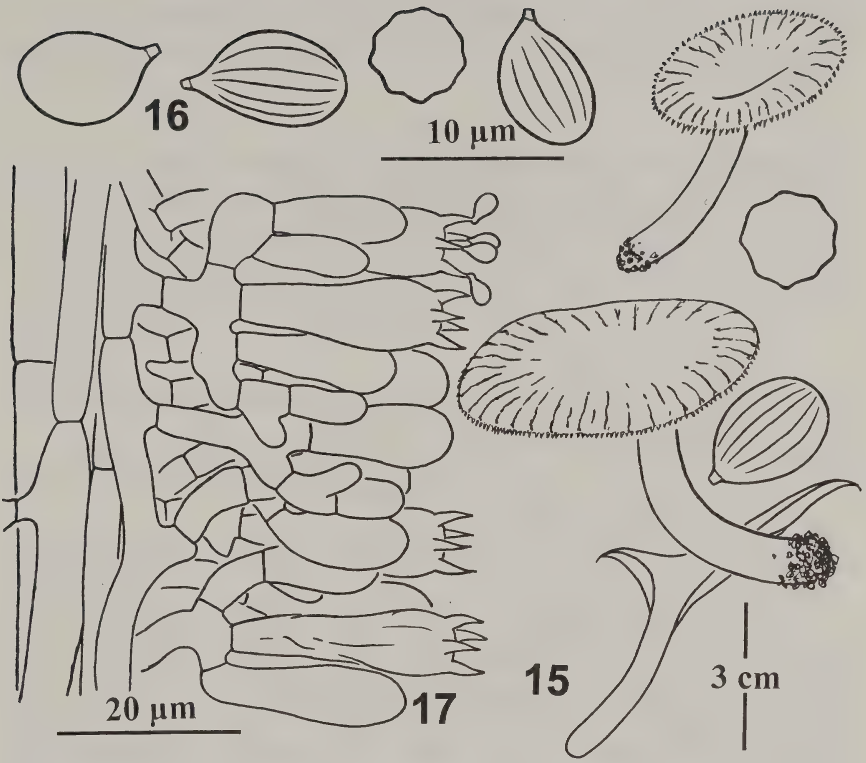
Spores [110/6/5] (5.5-)6.0-7.5(-9.0) × (4.0-)4.5-5.5(-6.0) μm [Q = (1.10-)1.20-1.50(-1.70), **Q** = 1.36 ± 0.11], ovoid to broad ellipsoid to ellipsoid in side view, angular in apical view, with 8-11 low longitudinal ridges, thin-walled, hyaline to subhyaline. Basidia 20-30 × 8-10 μm, subclavate, 4-spored, rarely 1-, 2-, or 3-spored; sterigmata about 3 μm long; basal septa without clamps; subhymenium consisting of short segments, 3-5 μm wide; hymenophoral trama more or less regular, with thin-walled hyphae 3-7 μm wide; pleurocystidia and cheilocystidia absent.

Habitat: on soil, usually on slopes of roadsides.

Specimens examined: Yunnan Prov.: Mengla County, Xishuangbanna Tropical Botanic Garden, alt. 580 m, 4. VIII. 1988, Z. L. Yang 270 (HKAS 21819) & 271 (HKAS 21820); 17. X. 1989, Z. L. Yang 704 (HKAS 22146); 21. X. 1989, Z. L. Yang 768 (HKAS 22147). Jinghong: Damenglong, alt. 650 m, 14. VIII, 1995, Z. L. Yang 2175 (HKAS 29488).

Distribution: Viet Nam. It is new to China.

Remarks: Boedijn (1951) treated *C. crispus* as a synonym of *C. apalus* (Berk. & Br.) Petch without any explanation. Pegler (1977 & 1986) hadn't listed *C. crispus* as a synonym of *C. apalus*. *Clitopilus apalus* seems to possess a smooth pileus (Pegler, 1977 & 1986). For the time



Figs. 15-17: *Clitopilus crispus* (HKAS 29488). 15. basidiocarps; 16. spores; 17. hymenium, subhymenium and hymenophoral trama.

being, the author inclines to treat *C. crispus* separately because the pilei of all specimens cited above have a finely subfimbriate pileal margin with subradially arranged low ridges. In China collections of *Clitopilus crispus* might be wrongly identified as *C. prunulus* (Scop.: Fr.) Kummer (Chang & Mao, 1995; Huang, 1998). Study of a collection of the latter species from Germany (Herbarium F. Oberwinkler 20563) shows that the spores have 5-6(-7) longitudinal ridges and are significantly larger, [20/1/1] 10.0-12.5(-19.0) × (4.5-)5.0-6.5(-7.0) µm, with Q = 1.91-2.5 (-2.83), **Q** = 2.29 ± 0.26.

Acknowledgements

I am grateful to Prof. Dr. F. Oberwinkler, Universität Tübingen, and Prof. M. Zang, Kunming Institute of Botany, for their guidance. I thank Prof. M. Zang, Prof. P. G. Liu and Mr. G. Song, who have collected some valuable specimens for my study. I gratefully acknowledge Dr. R. E. Halling, the New York Botanic Garden, Bronx, for reviewing this article.

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MYCOTAXON
Volume LXXIV(1), pp. 57-76 January-March 2000

TuberKey: A DELTA-BASED TOOL FOR THE DESCRIPTION AND INTERACTIVE IDENTIFICATION OF TRUFFLES

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ABSTRACT

Forty-five descriptors of truffle morphology and habitat/host plant preferences were coded in a format adhering to the DELTA (DEscription Language for TAxonomy) standard. Character states, both qualitative and quantitative, were described for 18 truffle species. Special care was taken in the description of taxa belonging to the so-called 'white' and 'whitish' truffles, which are often difficult to identify simply on the basis of traditional morphological characters, while available literature data corroborated by direct observations of fresh ascocarp samples were utilized for the other truffle species. For a subset of taxa in our study sample, species-specific molecular markers and anatomo-morphological characters of the mycorrhizae were also annotated. DELTA descriptors were used to develop TuberKey, a package of illustrated information and identification programs that allows the use of interactive keys to search and interrogate the entire character database and to recognize truffle species. Interactive identification can be conducted locally on a personal computer, or through the Internet via the World Wide Web. Other facilities provided by TuberKey are the automatic generation of new keys and natural language descriptions, and data transformation for morphology-based cladistic analyses. The DELTA database of truffle characters as well as the identification software can be accessed at the URL: http://www.truffle.org/tuberkey.

Key words: truffles, *Tuber*, DELTA, WebDelta, taxonomy, morphological characters.

Extensive morphological convergence, sharing of similar habitats, and coexistence in the same geographic area may all confound the recognition of truffle species belonging to the genus *Tuber* (Pezizales: Tuberaceae). Various biochemical (Pacioni and Pomponi, 1989; Pacioni et al., 1997) and molecular biological (Bertini et al., 1998; Gandeboeuf et al., 1997; Lanfranco et al., 1998; Rubini et al., 1998) methods for the unambiguous identification of truffles have been reported in recent years. Nevertheless, the correct assessment of market truffle value, the prevention of commercial frauds, and the documentation of *Tuber* biodiversity by field studies, would all benefit from a reliable, morphology-based identification method, also accessible to non-specialists. A significant advance in this direction can be afforded by computer-assisted recognition methods. The implementation of these new recognition tools rests upon the preliminary definition of character descriptors and the codification of the corresponding character states into a computer-manageable format. DELTA (DEscription Language for TAxonomy) is the most widely used format for taxonomic data codification and represents a powerful method to record character descriptions for computer processing (Dallwitz, 1980). It can be adapted to various software applications and has already been applied successfully to a variety of organisms including plants (Aiken et al., 1997), insects (Christiansen et al., 1990) and viruses (Boswell et al., 1986). Importantly, associated with the DELTA format are sets of computer programs that provide facilities for the generation and typesetting of descriptions, and for interactive identification and information retrieval (Dallwitz et al., 1993).

In the area of mycology, DELTA has been applied recently to the codification of the anatomo-morphological characters of the mycorrhizae from different orders of fungi (Rambold and Agerer, 1997). The practical value and resolution capacity of DELTA, however, may both gain from the use of multiple readily accessible characters, such as those of the ascocarps, and from its application to a rather restricted set of commercially valuable fungi, such as ascomycetous truffles. We thus set out to develop TuberKey, a package that includes a DELTA database, illustrated information, and programs for the interactive identification of truffles. The database presently contains 18 species, but it can be easily extended by any external user to include other truffles or to improve the description of those already present.

MORPHOLOGICAL ANALYSIS

Anatomo-morphological data for *Tuber panniferum* Tul. & C. Tul., *T. maculatum* Vittad., *T. magnatum* Pico, *T. borchii* Vittad. and *T. dryophilum* Tul. & C. Tul. were obtained from the examination, for each truffle species, of at least 5 ascocarps collected in different geographic areas (Table 1). Fresh truffles (collected by no more than 2 days) were initially identified and catalogued; the name, altitude, exposure and habitat of the site of collection were annotated, together with the date of collection and the putative type of host plant. Macroscopical characters, such as the size, the presence of an orifice or cavity and the shape of the ascocarp, the color and external surface features of the peridium, the color of the gleba and the form of the vein mesh, were evaluated by visual inspection. Individual ascocarps were then microscopically examined. The type, shape and size of peridium ornamentation and the size of fertile and sterile veins were examined with a Zeiss stereomicroscope SR at a magnification of x 25. Cryostat (Tissue-Tek' Miles) and hand-cut sections of individual ascocarps, including the gleba and the peridium, were used for optical microscope analysis (Leitz Laborlux 12). The total thickness of the peridium, as well as the thickness of the inner and the outer layer were measured at a magnification of 100x; for each specimen, four different, randomly chosen areas of the peridium were analyzed. The sizes of external and internal peridial cells were also measured by determining (at a magnification of 400x) the maximum and minimum dimensions of five contiguous cells within a randomly chosen area. Other peridium features that have been examined are the color of the different layers, the presence, length and basal diameter of cystidia, the presence and number of septa. The anatomo-morphological features of cells associated to sterile veins in the gleba were similarly analyzed by optical microscopy at a 650x magnification. For each sample, ten randomly chosen asci were analyzed at a magnification of 400x. The shape, the color, the size (maximum and minimum dimensions excluding ornamentation), and the number of spores were evaluated. As recommended by Gross (1987), only tetraspore asci, where present, were subjected to morphometric analysis. This included the color, the shape, and the dimensions of spores determined at a 630x magnification. Spores devoid of ornamentations as well as ornamented spores were considered; in the latter case, both the type and the size of sporal ornamentations were recorded. For reticulate spores, the size and the number of meshes along the main axis of the spore were determined. The mean value, the standard deviation, the range of variation, and limit values were calculated for each species; the height of spore ornamentations was determined according to the formula of Gross (1987). All the above data were determined for each numerical character, while alternative, qualitatively different states were established for individual descriptive characters. All specimens were then dried up in an air-convection dessicator, catalogued and stored into our herbarium (CMI-UNIBO) as vouchers.

Available literature data were utilized to describe the mycorrhizae of *Tuber maculatum, T. magnatum, T. borchii, T. brumale* Vittad., *T. aestivum* Vittad., *T. dryophilum, T. puberulum* Berk & Br., *T. melanosporum* Vittad., *T. uncinatum* Chatin, *T. macrosporum* Vittad. *and T. indicum* Cooke & Masee (Table 1). For 12 taxa previously subjected to molecular analysis, species-specific molecular markers derived from the ITS ribosomal DNA region were also considered (Table 1).

DATA RECORDING

Anatomo-morphological data were digitized using the *ad hoc* developed software package WebDelta. WebDelta is an application written in the Perl language that allows to maintain any DELTA database through the Internet. WebDelta directly reads the information contained in the “character” and “specification” files of the DELTA format and output a Web form consisting of multiple choice queries, numerical and text fields. The validity of numerical fields is verified with Java routines, and, in the case of an error, an alert message is displayed. Upon data submission, queries are translated into the DELTA format and saved as an ASCII file. For each data submission, the username, the taxon and the date are registered into a log file. Prior to any upgrading of the database, a backup copy of the file is automatically created. WebDelta is retrievable at the URL http://www.truffle.org/webdelta.html.

Photographs and drawings were used to document both macroscopical and microscopical characters. All photographic slides were digitized and the images were stored in a BMP format. Image manipulation was limited to cropping, scaling, and sharpening, and was performed with Adobe PhotoShop. The resulting files were stored in a JPEG format and subsequently converted into a GIF format for use in the INTKEY package. Image labeling was done with the DELTA software INTMATE.

CHARACTER DESCRIPTION IN THE DELTA FORMAT

A set of 43 macroscopical and microscopical features of the peridium, spores and gleba, plus two characters regarding the habitat and the putative host plant was initially selected as the basis for an informative description of truffles. This set of character descriptors includes 17 of the 25 characters originally proposed by Trappe as the key for the different genera of hypogeus ascomycetes (Trappe, 1979) and 28 additional characters. Among the latter, 14 describe anatomical features, common to various hypogeus genera, such as the biometric characteristics of the peridium, ascii and spores, while the other 14 characters are peculiar of the genus *Tuber*.

Table 1. Truffle species sampled for character description

Species	Collection locality	Specimen number	GenBank Acc. Number	References
T. magnatum	Pianoro, Bologna Pianoro, Bologna Pianoro, Bologna Budrio, Bologna Sant'Agostino	1160-30 1208-34 1208-35 1219-36 1289-44	TMAJ2509	**1**,*2*,*3*,*4*,*5*,*6*
T. borchii	Pianoro, Bologna Pianoro. Bologna Marina di Ravenna Marina di Ravenna Monterenzio, Bologna Monterenzio Bologna	1166-9 1178-11 1183-8 1183-15 1185-20 1185-24	AF003920	*7*,*4*,**8**,*6*,*9*
T. maculatum	Molinella, Bologna Molinella, Bologna Molinella, Bologna San Lazzaro, Bologna San Lazzaro, Bologna	1095-3 1096-10 1104-14 1146-28 1146-29	AF003919	*10*,**8**
T. puberulum	Pianoro, Bologna Pianoro, Bologna Pianoro, Bologna Pianoro, Bologna Pianoro, Bologna	1107-11 1108-12 1141-15 1260-44 1276-52	AF003918	*11*,**12**,**8**
T. dryophilum	Pianoro, Bologna Monterenzio, Bologna Pianoro, Bologna Marina di Ravenna San Lazzaro, Bologna	1192-21 1196-22 1199-23 1202-24 1248-26	AF003917	**8**
T. panniferum	Montagnola Senese, Siena Montagnola Senese, Siena Montagnola Senese, Siena Montagnola Senese, Siena Montagnola Senese, Siena	1234-1 1234-2 1234-3 1234-4 1234-5	AF073510	**1**
T. rufum				**12**,*13*,**8**,*14*
T. foetidum	Pianoro, Bologna	1153-7		**12**,**8**
T. excavatum			AF073509	**12**,**8**
T. uncinatum	Pavullo, Modena San Lazzaro, Bologna Pianoro, Bologna	1297-1 1291-12 1152-8		**15**,*16*
T. aestivum			U95175	**15**,**8**,*6*,*9*
T. indicum	Imported from China Imported from China Imported from China Imported from China	1080-1 1252-1 1343-1 1344	TIU89360 TIU89361 TIU89362	*17*,**18**,*19*,**20**
T. melanosporum			TMU89359	**1**,*3*,**12**,*6*,*9*
T. brumale			AF001010	**1**,*3*,**12**,**8**,*6*,*9*
T. macrosporum				**1**,*3*,**8**,*6*
T. pseudoexcavatum				**21**
T. mesentericum				**1**,*3*,**12**,**8**,*6*,*9*
Choiromyces meandriformis			AF003910	**1**,**8**

These are the morphology of peridium warts and cystidia, ascocarp veins, the height of sporal ornamentations and the number of meshes within the spore reticulum. A set of 14 characters regarding morphological features of the mycorrhizae has also been included. Such characters were selected as those that exhibit the highest variability among truffle species, but are least affected by the particular type of host plant. Molecular characters, in the form of theoretical restriction fragment length polymorphisms (RFLPs) obtained by digestion of the ITS1-5.8S-ITS2 ribosomal DNA region with three different endonucleases (*EcoRI*, *SphI* and *HincII*) were also considered. These highly discriminating markers, which in this group of fungi show very little (if any) intraspecific variation, may be used to distinguish between taxa that are very closely related morphologically (see below), or in cases in which only very small or deteriorated samples are available for identification. The complete list of characters and character state descriptors is reported in Appendix 1.

Beyond their subdivision into ascocarp morphology (43), habitat and host plant (2), molecular (3) and mycorrhizal (14), these characters can also be distinguished operationally according to their readiness of evaluation. In fact, molecular and mycorrhizal characters are in general more difficult to assess than ascocarp characters. Among the latter, one can further distinguish between easily discernible characters (e.g. # 2-6, 9 and 10 in Appendix 1), whose evaluation does not require any specialized instrumentation nor a skilled operator, and other, less accessible characters (e.g. # 11-29 in Appendix 1).

Sixteen truffle species widely diffused in Italy, plus two Asiatic truffles (*Tuber indicum* and *T. pseudoexcavatum* Wang *et al.)* often involved in commercial frauds, have been considered in the present analysis (Table 1). They all belong to the genus *Tuber* with the exception of *Choiromyces meandriformis* Vittad. that, although not assigned to the Tuberaceae by current taxonomic classifications, has been shown to be strictly related to the genus *Tuber* by recent molecular phylogenetic studies (O'Donnell et al., 1997; Percudani et al., 1999). The ascocarps of five "white" or "whitish" truffles (Table 1), which are poorly described in the literature, were directly examined both macroscopically and microscopically, while available morphological data were utilized for the ascocarps of the remaining 13 species.

All characters, both numerical and descriptive, were encoded in the DELTA format. The DELTA syntax has a great versatility for the description of morphological characters, but does not incorporate any facility for the proper handling of molecular data. To overcome this limitation, ribosomal DNA polymorphisms were described with character states corresponding to all possible DNA fragment lengths. Accordingly, the fragments produced by the three restriction enzymes we selected as the most diagnostic, was subdivided into size classes spaced by 50 base pairs that were then encoded as an unordered multistate (Appendix 1, characters #47-49). A 50 base pairs step was chosen because it represents the resolution limit of commonly used agarose gel electrophoresis methods.

Note to Table 1. References in bold-face and in italics pertain, respectively, to ascocarp and to mycorrhiza characters. **1**. Ceruti (1960); *2*. Fontana et al. (1990); *3*. Granetti (1995); *4*. Granetti et al. (1995); *5*. Palenzona and Fontana (1978); *6*. Zambonelli et al. (1993); *7*. Fontana et al. (1992); **8**. Pegler et al. (1993); *9*. Zambonelli et al. (1995); *10*. Fassi and Fontana (1967); *11*. Blaschke (1987); **12**. Gross (1987); *13*. Palenzona et al. (1972); *14*. Pirazzi (1998); **15**. Chevalier and Frochot (1997); *16*. Zambonelli and Govi (1990); *17*. Comandini and Pacioni (1997); **18**. Garcia Montero et al. (1997); *19*. Zambonelli et al. (1997); **20**. Zhang and Minter (1988); **21**. Wang et al. (1988).

Character descriptions were digitized in the DELTA format using the dedicated software WebDelta, which employs the "character" and "specification" files of the DELTA format to automatically build a Web interface capable of creating and upgrading an "item" database. With the aid of a Web browser, any user can fill out individual states of the character description form and introduce comments to all numerical and text fields as well as to any particular state through multiple choice queries. The main advantage of WebDelta is that a single DELTA database, containing character descriptions, can be accessed and modified through the Internet without any prior knowledge of the DELTA syntax.

THE DELTA DATABASE OF TRUFFLE CHARACTERS

The complete set of DELTA-encoded character states for the 18 truffles under examination is shown in Table 2. Although the characters are not fully described for all 18 truffle species, this does not preclude the use of the DELTA database for identification, catalogation and cladistic purposes. It should also be noted that molecular characters states (#47-49) have been described using the logical 'or' (/) instead of the 'and' (&) operator. For example, the pattern produced by digestion of the ITS region of *Tuber borchii* with *HincII* contains three DNA fragments of 56, 105 and 408 base pairs. Such fragments have been encoded as 2/3/6, and it is sufficient to choose any one of these three states to sort out *Tuber borchii* as a candidate species. Although less stringent, the use of the logical 'or' operator decreases the possibility of errors during identification.

The discrimination capacity of the DELTA database varies for different subsets of truffles and depends on the number of available characters as well as on intrinsic morphological similarities among truffle species. To visualize the characters that are capable of species discrimination in a complete set of pairwise comparisons, a matrix of non-overlapping character state differences was generated using the "Difference" command of the INTKEY software (Dallwitz, 1980) (Table 3). As expected, the number of differentiating characters largely varies for different groups of taxa, and it is lowest for highly related groups such as the white and the whitish truffles (Table 3, upper left corner). More specifically, this cross-comparison matrix shows that no character, other than RFLP markers, unambiguously discriminates between *Tuber borchii* and *T. puberulum*. In fact, the only potential distinguishing feature is "spore shape", a partly overlapped character which can vary from ellipsoidal/subglobose in *Tuber borchii* to globose/subglobose in *T. puberulum*. Only one morphological character in our dataset, namely the presence of external cystidia in the peridium, fully distinguishes *Tuber magnatum* and *T. dryophilum*. A similar case is found within the black truffles for *Tuber aestivum* and *T. uncinatum*, where the only differentiating character is the length of spore ornamentations This character, however, is a quantitative one and this makes even more challenging the discrimination between these two morphotypes whose actual species separation is still controversial (Chevalier and Frochot, 1997).

TuberKey IMPLEMENTATION

The DELTA database formed the core of TuberKey, a package of retrievable taxonomic information, bibliographic references, explanatory notes, illustrations and truffle identification tools. Included in TuberKey are 62 photographs and 18 drawings regarding macroscopical and microscopical features of truffles and of their host plants that should help the user during the identification process. TuberKey offers a Web based identification system accessible through the Internet. This implementation utilizes the NAVIKEY software (http://www.herbaria.harvard.edu/computerlab/web_keys/navikey) for interactive queries of the truffle database. Although NAVIKEY does not incorporate all the features of standard taxonomic description languages, it has the great advantage of requiring only commonly used web browsers for interactive identification.

TuberKey also offers a stand-alone version that can be queried on a personal computer by means of INTKEY (Dallwitz et al., 1993), a Windows-based program for the interactive access to DELTA format data. This software has several useful features: displaying of full or diagnostic descriptions of taxa; detection of differences or similarities between any group of taxa in terms of any set of characters; entry and deletion of descriptors in any order during identification; allowance for errors, either made by the user during data entry or present in the recorded dataset; estimates of variability or uncertainty in attributes; direct processing of numerical values, including ranges and non-contiguous sets of values. In addition, INTKEY can rank the various characters according to their reliability and distribution in the group of taxa under examination. Although the program suggests a list of characters ranked according to their resolving power, the user can choose any sequence of descriptors without following a predetermined order. This flexibility may be particularly significant in the case of truffles, where the ascocarp of a certain species may only be available for a restricted growing season, in a particular stage of maturation or conservation status, and/or collected at distant sites, thus needing to be preserved in a dried state.

Another useful feature offered by the DELTA database is the possibility to readily translate character descriptors into other formats, including those for cladistic analysis and natural language description. An example of the natural language description of *T. magnatum,* produced by TuberKey using the CONFOR software (Dallwitz et al., 1993), is reported in Appendix 2.

CONCLUSIONS

The codification into a standard format of 45 ascocarp anatomo-morphological characters, 2 habitat-related descriptors, and corresponding character state descriptions for 18 species of truffles formed the basis for the creation of TuberKey. Critical for the development of TuberKey was the set up of WebDelta for character state codification. This software offers two main advantages that should prompt the future expansion of the truffle database: i) character description is easily accessible to outside users as well as to multiple research groups through a computer connected to the Internet; ii) the input of data in standard format does not require any prior knowledge of the DELTA syntax. A schematic representation of the TuberKey database and of its applications is presented in Figure 1.

TuberKey is a new tool for truffle identification aimed at agricultural researchers, food inspectors, custom officers, mycologists, students, collectors and conservationists. Additional facilities provided by TuberKey are the guided access to species-specific molecular markers and to mycorrhizal morphology data for a subset of taxa, the automatic generation of new keys and natural language descriptions, and data transformation for morphology-based cladistic analyses of truffles.

Table 2. Character states of the 18 truffle species under examination

CHARACTER	*T. magnatum*	*T. borchii*	*T. maculatum*	*T. puberulum*	*T. dryophilum*	*T. panniferum*	*T. rufum*	*T. foetidum*	*T. excavatum*
2	1/2/3	1/2/3	1/2	1/2	1/2	1/2/3	1/2	1/2	1/2
3	1	1	1	1	1	2	1	1	2
4	1-6(-20)	(0.5-)1-5(-10)	(0.3-)0.5-1.5-2.5(-4)	0.5-1	0.5-4	0.4-5	0.5-2(-4)	0.6-3(-4)	1-3.5(-5)
5	3/4/5/6	3/4/5/6	3/4/5/6	3/4/5/6	3/4/5	5	13/5/6	5/6	11/3/4/5
6	1	1	1	1	1	1	1	1	1
7	-	-	-	-	-	-	-	-	-
8	1	4	1	4	1	3	2	2	1/2
9	2/3/6/7	6	2/3/6	2/6	2/6	2/6	5/6	5/6	3/6
10	2	1	1	1	2	1	1	1	1
11	(253-)337-421-505(-532)	(133-)263-405-547(-713)	(293-)383-536-689(-851)	150-200	(186-)216-301-386(-452)	(228-)313-439-565(-695)	250-400	250-400(-500)	200-350
12	(27-)45-78-111(-146)	(115-)115-206-300(-399)	(53-)54-87-120(-133)	?	(65-)68-112-156(-199)	(76-)113-182-251(-283)	80-90	?	30-40
13	1/2	1/2	1/2	1/2	2	2	2	2/3	1/2
14	2	1/2	2/3	1/2	1/2	1/2	1	1/2	2
15	(3-)9-12-15(-16)	(6-)9-15-21(-29)	(5-)11-16-21(-30)	10-15	(6-)9-15-21(-21)	(6-)8-11-14(-17)	12-15	(11-)18-26(-32)	8-15
16	(3-)6-9-12(-13)	(3-)7-10-13(-16)	(3-)4-9-14(-26)	?	(6-)7-11-15(-16)	(3-)5-7-9(-13)	12-15	(11-)18-26(-32)	8-15
17	(186-)251-336-421(-479)	(66-)82-232-382(-465)	(319-)322-480-638(-784)	?	(47-)92-162-232(-292)	(22-)104-187-270(-370)	150-300	?	160-320
18	1	1	1	1	1	?	?	1	1
19	3	3	3	?	?	2	3	2/3	3
20	(3-)3-6-9(-10)	(3-)7-11-15(-16)	(3-)4-10-16(-26)	?	(3-)3-6-9(-10)	(3-)11-15-19(-25)	4-5	?	?
21	(3-)3-5-7(-7)	(3-)5-6-7(-7)	(3-)3-5-7(-10)	?	(3-)3-5-7(-7)	(7-)8-12-16(-20)	4-5	?	?
22	2	1	2	1	1	1	2	2	2
23	-	(39-)41-55-69(-80)	-	60-110	(22-)22-31-40(-45)	(11-)15-118-221(-931)	-	-	-
24	-	(3-)4-5-6(-6)	-	4.5-9	(4-)4-7-10(-10)	?	-	-	-
25	-	1	-	1	1	1	-	-	-
26	-	1	-	1-4	1-2	?	-	-	-
27	50-160	?	?	?	?	?	?	?	?
28	2	2	2	2	2	1/2	?	1	?
29	?	?	?	?	?	?	?	?	?
30	2	2	2	2	2	2	½	2	2
31	(53-)61-69-77(-90)	(63-)71-83-95(-106)	(58-)63-75-85(-98)	80-108	(63-)77-90-103(-126)	(53-)61-71-81(-93)	57-83	60-90	95-135(-180)
32	(26-)42-53-64(-68)	(42-)54-66-78(-90)	(37-)45-54-63(-72)	66-95	(42-)55-66-77(-90)	(37-)49-60-71(-80)	44-63	45-60	85-105

Table 2. *continued*

CHARACTER	*T. uncinatum*	*T. aestivum*	*T. indicum*	*T. melanosporum*	*T. brumale*	*T. macrosporum*	*T. pseudoexcavatum*	*T. mesentericum*	*Choiromyces meandriformis*
2	1/3	1/3	1/2	1/3	1/2/3	1/2/3	1	1/3	1/3
3	1/2	1/2	1	1	1	1	2	2	1
4	1-10	1-10	(1-)1-3(-7)	1-7(-10)	0.5-5	1-4(-7)	3.5	1-5(-10)	3-8(-12)
5	13/5	13/5	13/5/6	13/5	13	13/2/5/6	11/5	13/2/5	1/3/4/5
6	2	2	2	2	2	1/2	2	2	1
7	2	2	1	2	1/2	1	1	2	-
8	-	-	-	-	-	2	-	-	1
9	6	3/6	9/10	6/9/10	2/10	2/6	2/6	2/6	1/3/6
10	2	2	2	2	1	2	1	2	2
11	200-400	200-400	550-800	400-700	100-150	200-300	290-500	?	150-200
12	50	50-150	500-600	200-300	70-100	80-100	190-350	?	?
13	2/3	2/3	3	3	3	3/4	3	?	½
14	1	1	2	2	1/2	3	2	?	2
15	10-15	10-15(-20)	10-20	5-15	?	?	10-20	?	15-30
16	10-15	10-15(-20)	10-20	4-10	?	?	10-20	?	10-20
17	150-300	150-300	50-200	200-400	30-50	120-200	100-140	?	?
18	1	1	1/2	1/2	1/2	2	1	?	1
19	3	3	3	2/3	3	3	3	?	3
20	?	?	3-5	4-8	?	?	3-9	?	6-9
21	3	?	3-5	4-8	?	?	?	?	?
22	2	2	2	2	2	2	2	2	2
23	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-
27	?	?	?	?	?	?	?	?	?
28	2	2	2	2	?	?	2	?	?
29	?	?	?	?	?	?	?	?	?
30	2	2	2	2	2	2	2	2	1
31	60-90(-110)	60-90(-110)	50	90-140	70-96	95-140	60-85(-105)	27-53	130-200
32	55-70	55-70	75	80-120	60-75	65-95	45-70	23-37	60-70

Table 2. *continued*

CHARACTER	*T. magnatum*	*T. borchii*	*T. maculatum*	*T. puberulum*	*T. dryophilum*	*T. panniferum*	*T. rufum*	*T. foetidum*	*T. excavatum*
33	1-4	(1-)1-4(-5)	1-3(-4)	1-4	1-4	(2-)5-6-7(-8)	1-5	1-4(-5)	(1-)3-5(-6)
34	1	1	1	1	1	1	1	1	1
35	?	?	?	?	?	?	?	?	?
36	?	?	?	?	?	?	?	?	?
37	4/5	3/4	3/4	4/5	4	4/5	3/4	3/4	3
38	(20-)22-25-28(-37)	(18-)25-29-33(-37)	(20-)25-30-35(-40)	28-31-34	(24-)28-31-34(-39)	(18-)19-24-29(-31)	22-27	24-26	28-31-35
39	(16-)19-21-23(-25)	(18-)22-26-30(-30)	(14-)20-23-26(-28)	28-31-34	(24-)27-29-31(-32)	(18-)21-24-27(-32)	16-21	20-21	(20-)22-25-28
40	½	2/3	1/2	2/3	1/2	2	2/3	2/3	½
41	2	2	2	2	2	1	1	2	2
42	(2-)3-4-5(-7)	(2-)3-4-5(-7)	-	?	(2-)3-4-5(-7)	(4.2-)5.1-6.5-7.3(-9.5)	2-3(-4)	4-5	?
43	(6-)8-10-12 (-16)	(3-)4-6-8(-9)	(3-)3-4-5(-7)	?	(3-)5-7-9 (-15)	-	-	(4-)6-15(-20)	3-6
44	(2-)3(-4)	(3-)4-5-6 (-10)	(3-)3-4-5(-6)	5-8	(3-)4-5-6(-7)	-	-	4-6(-7)	3-4
45	1	1	1	1	1	1	1	1	1
46	1/2/3/4/5/6/7	1/2/3/4/5/6/7/12/13	6/7/12	12	1/9/12	1	1/9/12	1/9	1/9
47	7	2/4	3	3	2/4	8	?	?	?
48	5/6	5	4/6	4/6	4/5	5/7	?	?	?
49	1/8	2/3/6	7	7	1/7	3/8	?	?	?
51	1/2	1/2	1/2	1/2	1/2	?	1/2	?	?
52	1	1	1	1	1	?	1	?	?
53	1	1	1	1	1	?	1	?	?
54	1/2/6	2/6	2/6	2/6	2/6	?	6	?	?
55	6/10	6/10	6/10	6/10	6/10	?	10	?	?
56	1/2	2	1/2	2	1/2	?	1	?	?
57	1	1	1	1	1	?	-	?	?
58	1	1	1	1	1	?	-	?	?
59	1	1	1	1	1	?	-	?	?
60	1	1	?	1	1	?	-	?	?
61	-	-	?	-	-	?	-	?	?
62	-	-	?	-	-	?	-	?	?
63	-	-	?	-	-	?	-	?	?
64	3	2/3	3	3	3	?	3	?	?

Table 2. *continued*

CHARACTER	*T. uncinatum*	*T. aestivum*	*T. indicum*	*T. melanosporum*	*T. brumale*	*T. macrosporum*	*T. pseudoexcavatum*	*T. mesentericum*	*Choiromyces meandriformis*
33	1-6(-7)	1-6(-7)	(1-)3-5(-6)	1-6	2-5	1-3	1-8	1-3(-4)	8
34	1	1	1	1	1	1	1	1	1
35	?	?	2	?	?	?	?	?	1
36	?	?	1	?	?	?	?	?	?
37	3/4	3/4	3/4	3	3	3	3	3	5
38	25-32	25-36	(25-)31(-38)	29-32-35	26-31	40-75	(23-)24-28 (-35)	31-33-36	16-20
39	17-28	18-28	(21-)25(-29)	20-23-26	18-23	30-50	16-19(-22)	24-26-29	16-20
40	1/2/3	1/2/3	5	4	1/2	4	4	2/3	1/2
41	2	2	1	1	1	2	1/2	2	1
42	4-5(-8)	1-2-3	3-6	2-3	3-4	3-4	5-8	?	3-6
43	?	?	-	-	-	?	?	?	-
44	3-5	3-5	-	-	-	7-9	?	?	-
45	1	1	?	1	1	1	?	1	1
46	1/2/3/4/5/ 9/10/12/13	1/2/3/4/9/ 10/12/13	1	1/2/3/4/ 5/11/12	1/2/5	1/6/7/10	12	1/3	1/5/9
47	?	?	3/4	3/4	4/6	?	?	?	4
48	?	?	5/6	5/6	8	?	?	?	5/7
49	?	?	2/3/6/8	2/3/6	2/4/7	?	?	?	1/8
51	1/2	1/2	1/2	1/2	1/2	1/2	?	1/2	?
52	1	1	1	1	1	1	?	1	?
53	1	1	1	1	1	1	?	1	?
54	2/6	2/6	2/6	2/6/10	2/6	2/6	?	2/6	?
55	6/10	6/10	6/10/11	6/10	6/10	6/10	?	6/10	?
56	1/2	1/2	1/2	1/2	1/2	1/2	?	1/2	?
57	2	2	1	1	1	1	?	2	?
58	3	3	2	2/3	2	2/3	?	3	?
59	2	2	1	1	1	2	?	1	?
60	1	1	2	1/2	1	2	?	1/2	?
61	-	-	2	2	-	2	?	1	?
62	-	-	1/2	1/2	-	2	?	2	?
63	-	-	1/2/3	1/2	-	2/3	?	1	?
64	1	1	1/3	2/3	3	3	?	1	?

Note. Character states have been codified with the DELTA syntax (see also Appendix 1). The '/' separator of multistate characters corresponds to an 'or'. Numeric characters are given as follows: numbers in parentheses denote extreme values; numbers not in parentheses represent the range of variation and the mean value. When only one number is given it corresponds to the mean value, while when two numbers are given they correspond to the range of variation and the mean is omitted. The annotations '-' and '?' indicate, respectively, inapplicable characters and characters that have not been described.

Table 3. Character differences among the 18 truffle species under examination

	T. borchii (54)	T. maculatum (48)	T. puberulum (46)	T. dryophilum (53)	T. panniferum (38)	T. rufum (39)	T. foetidum (32)	T. excavatum (32)	T. uncinatum (45)
T. magnatum (51)	8 10 22 47 49	10 47 49	8 10-11 22 39 44 46-47 49	22 47	3 8 10 19 22 41 47	8 10 14 41	8 10 28	3 10 31-32 37	6 14 57-59 64
T. borchii (54)		8 22 47-49	47-49	8 10 49	3 8 19 41 47	8 12 22 41 56	8 22 28	3 8 12 22	6 10 12 22 57-59 64
T. maculatum (48)			8 11 22	10 17 22 47	3 8 19 22 41 46-49	8 14 17 41	8 28 46	3 12 32 46	6 10 12 14 17 57-59 64
T. puberulum (46)				8 10 23 47	3 8 11 41 46-49	8 11 22 32 38-39 41 56	8 11 22 28 32 38-39 46	3 8 22 37 44 46	6 10 22 57-59 64
T. dryophilum (53)					3 8 10 41 47 49	8 10 22 39 41	8 10 22 28 39	3 10 12 22 37	6 12 22 57-59 64
T. panniferum (38)						3 8 19 21-22 42	3 8 22 41	8 12 19 22 31-32 37 41	6 10 12 19 21-22 41
T. rufum (39)							41	3 12 14 31-32 38 41	6 10 12 21 41 64
T. foetidum (32)								3 31-32 38	6 10 28
T. excavatum (32)									6 10 12 14 32
T. uncinatum (45)									
T. aestivum (44)									
T. indicum (52)									
T. melanosporum (51)									
T. brumale (43)									
T. macrosporum (45)									
T. pseudoexcavatum (32)									
T. mesentericum (35)									

Table 3. *continued*

T. aestivum (44)	T. indicum (52)	T. melanosporum (51)	T. brumale (43)	T. macrosporum (45)	T. pseudoexcavatum (32)	T. mesentericum (35)	Choiromyces meandriformis (34)	
6 14 57-59 64	6 9 11-13 31-32 40-41 47 58 60	6 12-13 32 37 40-41 47 49 58	5-6 10-11 13 17 37 41 47-49 58	8 13-14 18 31 37-40 44 58-60	3 6 10 12-13 17 37 40 46	3 6 37 57-58 64	11 30-31 33 41 47	T. magnatum (51)
6 10 22 57-59 64	6 9-10 12-13 22 31 40-41 58 60	6 10 13 22 40-41 58	5-6 9 12-13 17 22 41 48 58	8 10 12-14 18 22 38 40 58-60	3 6 13 22 40	3 6 10 22 31-32 57-58 64	8 10 22 30-31 33 37 41 49	T. borchii (54)
6 10 14 17 57-59 64	6 9-10 12-13 17 31-32 40-41 46 49 58	6 10 12-13 32 40-41 49 58	5-6 11 13 17 41 46-48 58	8 10 13 17-18 39-40 44 58-59	3 6 12-13 17 40	3 6 10 31 46 57-58 64	10-11 30-31 33 37 41 46-49	T. maculatum (48)
6 10 22 57-59 64	6 9-11 13 22 31 40-41 46 49 58 60	6 10-11 13 22 37 39-41 49 58	5-6 13 22 37 39 41 46-48 58	8 10 13-14 18 22 37-38 40 46 58-60	3-4 6 11 13 22 37 39-40	3 6 10 22 31-32 37 46 57-58 64	4 8 10 22 30-31 33 38-39 41 46-49	T. puberulum (46)
6 22 57-59 64	6 9 11-13 22 31 40-41 49 58 60	6 12-13 22 37 40-41 49 58	5-6 10-11 13 22 37 39 41 48 58	8 13-14 18 22 37-38 40 58-60	3 6 10 13 22 37 39-40	3 6 22 31-32 37 57-58 64	22 30-31 33 37-39 41	T. dryophilum (53)
6 10 19 22 41-42	3 6 9-10 12-13 19 21-22 31 40 47	3 6 10 13 22 37 40 42 47	3 5-6 11 13 19 22 37 42 47-49	3 8 10 13-14 19 22 31 37-38 40-42	6 13 19 22 37 40 46	6 10 22 37 41	3 8 10-11 19 22 30-31 47	T. panniferum (38)
6 10 41 64	6 9-14 31-32 40	6 10 12-14 16 31-32 38 40	6 9 11 13 17	10 13-14 31-32 38-41	3 6 12-14 17 40 42	3 6 10 31-32 38-39 41 64	8 10-11 14 20 31 33 37-38	T. rufum (39)
6 10 28 42	6 9-11 28 31-32 40-41	6 10 16 28 32 38 40-42	5-6 9 11 41	10 14 18 31-32 38-40	3 6 28 40 46	3 6 10 31-32 38-39	8 10-11 30-31 33 37-38 41	T. foetidum (32)
6 10 12 14 32	3 6 9-13 31-32 40-41	3 6 10-13 40-41	3 5-6 9 11-13 17 32 41	3 10 12-14 18 38-40 44	6 12-13 17 32 40 46	6 10 31-32	3 10 30 32-33 37-38 41	T. excavatum (32)
42	7 9 11-12 14 31-32 40-41 57-60	12 14 21 32 40-42 57 59 64	9-12 17 41 57-59 64	7 12 14 18 38-40 44 57 60 64	7 10 12 14 17 40	31-32 59	6 14 30-31 33 37-38 41	T. uncinatum (45)
	7 9 11-12 14 31-32 40-41 57-60	12 14 32 40-41 57 59 64	9-11 17 41 57-59 64	7 14 18 38-40 44 57 60 64	7 10 12 14 17 40 42	31-32 59	6 14 30-31 33 37-38 41	T. aestivum (44)
		7 12 31-32 40	10-12 31 40 48 60	9 11-12 14 31 38-41 59	3 9-12 31-32 40 46	3 7 9 32 40-41 57-58 61	6 9 11 13 20 30-33 35 37-40	T. indicum (52)
			10-12 17 32 40 48	7 11-12 14 38-39 41 59	3 7 10 17 32 42	3 31-32 40-41 57 61 64	6 11 13 30 32-33 37-38 40 49	T. melanosporum (51)
				10-11 14 17 38-41 59-60	3 5 11-12 17 40 42 46	3 10 31-32 39 41 57-58 64	5-6 9-10 13 30-31 33 37-38 48-49	T. brumale (43)
					3 10 12 14 18 38-39 42 46	3 7 31-32 38-40 57 59 61 63-64	8 13-14 18 30 33 37-41	T. macrosporum (45)
						7 10 31-32 39-40 46	3 6 10-11 13 30-31 37-38 40 46	T. pseudoexcavatum (32)
							3 6 30-33 37-39 41	T. mesentericum (35)

Note. The “differences” array was obtained with the INTKEY software using the command: DIFFERENCES (x, y) ALL, where x and y is any combination of two different truffle species. Numbers in parentheses below the species name indicate the number of characters that have been described for that particular taxon. Molecular characters have only been considered for those species having more than 500 base pairs of sequenced ITS region. Enclosed by a double boundary in the upper left corner are all the so-called white whitish truffles.

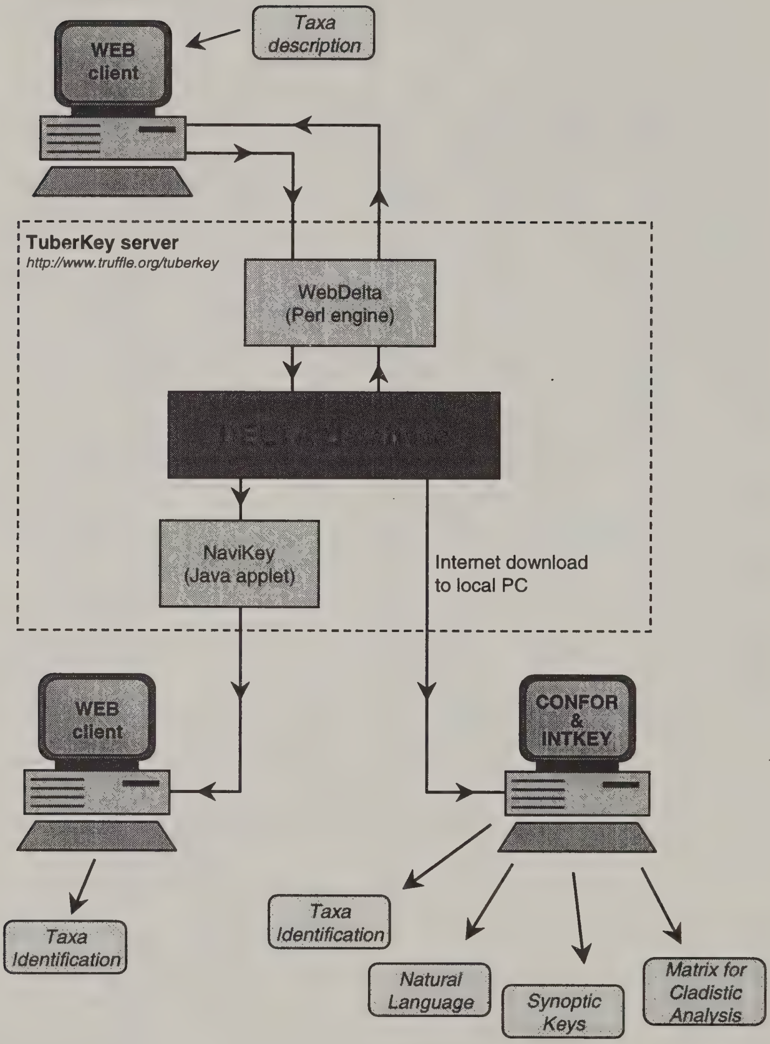
WEB client
Taxa description
TuberKey server
http://www.truffle.org/tuberkey
WebDelta (Perl engine)
NaviKey (Java applet)
Internet download to local PC
WEB client
CONFOR & INTKEY
Taxa Identification
Taxa Identification
Natural Language
Synoptic Keys
Matrix for Cladistic Analysis

Figure 1. Schematic representation of the TuberKey Web site (dashed box), illustrating the creation and the possible uses of the DELTA database of truffle characters.

ACKNOWLEDGMENTS

This work was supported by the National Research Council of Italy, Progetto Strategico CNR-Regioni, "*Tuber*: Biotecnologia della Micorrizazione".

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APPENDIX 1. THE CHARACTER LIST

1. <Nomenclature, comments, associations, bibliography>/

Ascocarp morphology

2. Ascocarp <shape>/
   1. subglobose/
   2. globose/
   3. lobed/

3. Ascocarp orifice or cavity <presence>/
   1. absent/
   2. present/

4. Ascocarp <dimension>/
   cm in diameter/

5. Ascocarp <surface color>/
   1. white/
   2. gray/
   3. yellow/
   4. ochre/
   5. brown/
   6. red/
   7. violet/
   8. purple/
   9. green/
   10. blue/
   11. orange/
   12. pink/
   13. black/

6. Ascocarp <surface configuration>/
   1. smooth <even>/
   2. with warts/

7. Ascocarp warts <with lens, type>/
   1. flat/
   2. angulated/

8. Ascocarp peridium <surface fine texture>/
   1. glabrous/
   2. scabrous <showing flat warts only with lens>/
   3. pubescent/
   4. finely pubescent <only with lens>/

9. Ascocarp color of spore-bearing tissue <at maturity>/
   1. white/
   2. grey/
   3. yellow/
   4. pink/
   5. red/
   6. brown/
   7. olive/
   8. violet/
   9. purple/
   10. black/

10. Ascocarp veins <gleba>/
    1. large and rare/
    2. narrow and numerous/

11. Peridium <thickness>/
    micron/

12. Peridium outermost layers <thickness>/
    micron/

13. Peridium <outermost layers color>/
    1. hyaline/
    2. yellow-brown/
    3. red-brown/
    4. brown/

14. Peridium anatomical structure <outermost layers>/
    1. pseudoparenchymatic with angular cells/
    2. pseudoparenchimatic with roundish cells/
    3. plectenchymatic/

15. Peridium cell tangential dimension <outermost layers>/
    micron/

16. Peridium cell radial dimension <outermost layers>/
    micron/

17. Peridium innermost layers <thickness>/
    micron/

18. Peridium color <innermost layers>/
    1. hyaline/
    2. yellow-brown/
    3. red-brown/
    4. brown/

19. Peridium anatomical structure <innermost layers>/
    1. psedoparenchimatic with angular cells/
    2. pseudoparenchimatic with roundish cells/
    3. plectenchymatic/

20. Peridium cell tangential dimension <innermost layers>/
    micron/

21. Peridium cell radial dimension <innermost layers>/
    micron/

22. Peridium external cystidia <presence>/
    1. present/
    2. absent/
23. Cystidia length/
    micron/
24. Cystidia basal diameter/
    micron/
25. Cystidia septa <presence>/
    1. present/
    2. absent/
26. Cystidia <septa number>/
27. Sterile veins <thickness>/
    micron/
28. Sterile veins <anatomical features>/
    1. pseudoparenchimatic/
    2. plectenchimatic/
29. Fertile veins <thickness>/
    micron/

Asci and spores morphology

30. Asci <shape>/
    1. sacata/
    2. globose/
    3. cylindrical/
31. Asci major axis <dimension>/
    micron/
32. Asci minor axis <dimension>/
    micron/
33. Asci number of spores per ascus <at maturity>/
34. Asci <spore arrangement>/
    1. irregularly clustered/
    2. regularly clustered/
35. Asci iodine reaction <in Melzer's reagent>/
    1. yellow/
    2. orange/
    3. blue only near ascus apex/
    4. diffusely green or blue over most of ascus/
36. Asci color in KOH/
    1. hyaline/
    2. brown/
37. Spores <shape>/
    1. fusoid/
    2. cylindric/
    3. ellipsoid/
    4. subglobose/
    5. globose/
38. Spores major axis <lenght excluding ornamentation in 4-spore asci>/
    micrometer lenght/
39. Spores minor axis <lenght excluding ornamentation in 4-spore asci>/
    micrometer lenght/
40. Spores color <at maturity>/
    1. yellow/
    2. pale brown/
    3. medium brown/
    4. dark brown/
    5. nearly opaque/
41. Spores <ornamentation at maturity>/
    1. spines/
    2. reticulation/
42. Spores ornamentation length/
    micron/
43. Spores mesh width <ornamentation>/
    micron/
44. Spores number of meshes along the major axis <ornamentation>/

Distribution

45. Habitat/
    1. temperate/
    2. boreal/
    3. tropical/
    4. subalpine/
    5. subartic/
    6. desert/
46. Putative plant host/
    1. Quercus/
    2. Corylus/
    3. Ostrya/
    4. Carpinus/
    5. Tilia/
    6. Populus/
    7. Salix/
    8. Alnus/
    9. Fagus/
    10. Castanea/
    11. Cistus/
    12. Pinus/
    13. Cedrus/
    14. Abies/

DNA polymorphism

47. ITS restriction pattern with EcoRI/
    1. 50-100 bp/
    2. 200-250 bp/
    3. 250-300 bp/
    4. 300-350 bp/
    5. 400-450 bp/

    6. 550-600 bp/
    7. 600-650 bp/
    8. 650-700 bp/

48. ITS restriction pattern with SphI/
    1. less than 50 bp/
    2. 50-100 bp/
    3. 100-150 bp/
    4. 200-250 bp/
    5. 250-300 bp/
    6. 300-350 bp/
    7. 350-400 bp/
    8. 900-950 bp/

49. ITS restriction pattern with HincII/
    1. less than 50 bp/
    2. 50-100 bp/
    3. 100-150 bp/
    4. 300-350 bp/
    5. 350-400 bp/
    6. 400-450 bp/
    7. 500-550 bp/
    8. 550-600 bp/

50. DNA sequence ID of the ITS1-5.8S-ITS2 regions/

Mycorrhizae morphology

51. Mycorrhizae emanting hyphae/
    1. absent/
    2. rare/
    3. abundant covering the roots/

52. Mycorrhizae anatomy of emanating hyphae: clamps <presence>/
    1. absent/
    2. present/

53. Mycorrhizae color of emanating hyphae/
    1. hyaline/
    2. braun/
    3. black/

54. Mycorrhizae color of very tip/
    1. white/
    2. whitish/
    3. yellow/
    4. orange/
    5. reddish/
    6. ochre, yellowish brown/
    7. greyish/
    8. violet/
    9. greenish/
    10. brown/
    11. black/

55. Mycorrhizae color of older parts/
    1. white/
    2. whitish/
    3. yellow/
    4. orange/
    5. reddish/
    6. ochre, yellowish brown/
    7. greyish/
    8. violet/
    9. greenish/
    10. brown/
    11. black/

56. Mycorrhizae cystidia <presence>/
    1. absent/
    2. present/

57. Mycorrhizae <cystidia shape>/
    1. needle like/
    2. wolly/

58. Mycorrhizae color <cystidia>/
    1. hyaline/
    2. pale yellow/
    3. ochre/
    4. brown/

59. Mycorrhizae intercalate swelling <cystidia, presence>/
    1. absent/
    2. present/

60. Mycorrhizae ramification <cystidia, presence>/
    1. absent/
    2. present/

61. Mycorrhizae <cystidia ramification frequence>/
    1. rare <less tha in 10% of cystidia>/
    2. abundant <more tha in 10% of cystidia>/

62. Mycorrhizae <cystidia ramification type>/
    1. monopodial/
    2. dichotomous/

63. Mycorrhizae <cystidia ramification position>/
    1. proximal/
    2. medial/
    3. distal/

64. Mycorrhizae anatomy of the mantle <in the plan view>/
    1. pseudoparenchymatus with angular cells/
    2. pseudoparenchymatus with rounds cells/
    3. pseudoparenchymatus with epidermoid hyphal cells "like a puzzle"/
    4. plectenchimatous/

APPENDIX 2. A NATURAL-LANGUAGE DESCRIPTION

The description was automatically generated from the DELTA database using the CONFOR program. Natural-language descriptions of all the examined taxa are available at the URL: http://www.truffle.org/tuberkey/natlang-english/index.htm.

Tuber magnatum

Tuber magnatum Pico In Melethemata inauguralia de fungorum generatione et propagatione: 80(1788) specimens examined: CMI-UNIBO 1160-30 CMI-UNIBO 1208-34 CMI-UNIBO 1208-35 CMI-UNIBO 1219-36 CMI-UNIBO 1289-44.

Ascocarp morphology. Ascocarp subglobose or globose or lobed, orifice or cavity absent, 1-6(-20) cm in diameter, yellow or ochre or brown or red, smooth, peridium glabrous, color of spore-bearing tissue grey or yellow or brown (hazel) or olive, veins narrow and numerous. Peridium (253-)337-421-505(-532) micron, outermost layers (27-)45-78-111(-146) micron, hyaline or yellow-brown (yellowish), anatomical structure pseudoparenchimatic with roundish cells, cell tangential dimension (3-)9-12-15(-16) micron, cell radial dimension (3-)6-9-12(-13) micron, innermost layers (186-)251-336-421(-479) micron, color hyaline, anatomical structure plectenchymatic, cell tangential dimension 3-6-9(-10) micron, cell radial dimension 3-5-7 micron, external cystidia absent. Sterile veins 50-160 micron, plectenchimatic.

Asci and spores morphology. Asci globose, major axis (53-)61-69-77(-90) micron, minor axis (26-)42-53-64(-68) micron, number of spores per ascus 1-4, irregularly clustered.
Spores subglobose or globose, major axis (20-)22-25-28(-37) micrometer lenght, minor axis (16-)19-21-23(-25) micrometer lenght, color yellow or pale brown, reticulation; ornamentation length (2-)3-4-5(-7) micron; mesh width (6-)8-10-12(-16) micron; number of meshes along the major axis (2-)3(-4).

Distribution. Habitat temperate; Putative plant host Quercus, or Corylus, or Ostrya, or Carpinus, or Tilia, or Populus, or Salix.

DNA polymorphism. ITS restriction pattern with *EcoRI* 600-650 bp; *SphI* 250-300 bp, or 300-350 bp; *HincII* less than 50 bp, or 550-600 bp; DNA sequence ID of the ITS1-5.8S-ITS2 regions TMAJ2509.

Mycorrhizae morphology. Mycorrhizae emanting hyphae absent, or rare; anatomy of emanating hyphae: clamps absent; color of emanating hyphae hyaline; color of very tip white, or whitish, or ochre, yellowish brown; color of older parts ochre, yellowish brown, or brown; cystidia absent, or present; needle like; color hyaline; intercalate swelling absent; ramification absent; anatomy of the mantle pseudoparenchymatus with epidermoid hyphal cells "like a puzzle".

MYCOTAXON

Volume LXXIV(1), pp. 77-81 January-March 2000

SOUTH AFRICAN FUNGI 11. SUILLUS SALMONICOLOR - A BOLETE NEW TO SOUTH AFRICA

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Suillus salmonicolor (Frost) Halling is recorded for the first time from South Africa, based on a collection made in Mpumalanga. The material, which is fully described, is compared and contrasted with *S. luteus* (Fr.) Roussel.

Key words: *Suillus salmonicolor, S. cothurnatus, S. pinorigidus, S. subluteus, S. luteus,* South Africa.

Introduction

In 1998 a gathering of a slimy bolete with a prominent glutinous ring was collected by Dr J. Duminy, and subsequently identified as *Suillus salmonicolor* (Frost) Halling, a species native to North America and not previously known from South Africa. It represents one of the few collections of this species outside of the North American continent.

S. salmonicolor shows certain similarities with *S. luteus* (Fr.) Roussel, which also occurs in South Africa, if rarely, and the two taxa could be confused at a casual glance. Indeed, it will be necessary in future to exercise care when naming these sticky annulate *Suillus* species associated with pines, even though both are fortunately edible. A description follows:

Suillus salmonicolor (Frost) Halling, Mycologia **75**, 85, 1983.
Boletus salmonicolor Frost, Bull. Buffalo Soc. Nat. Sci. **2**, 100, 1874.
Boletus subluteus Peck, Bull. N.Y. State Museum 1(2), 62, 1887.
Suillus subluteus (Peck) Snell, in Slipp & Snell Lloydia, **7**, 34, 1944.
Suillus cothurnatus Sing., Farlowia **2,** 261, 1945.
Suillus pinorigidus Snell & Dick, Mycologia, **48**, 304, 1956.

Pileus 5-8 cm diam., campanulate, becoming convex, surface viscid, initially yellowish cream, densely marked with innate, radiating, rivulose dark-brown lines; youngest specimens with a general purplish tint, but purple tints not visible in older fruit-bodies. **Pores** dark yellow-brown, sometimes with olive tint. **Tubes** to 11 mm long, concolorous with the pores. **Stipe** 60-90 mm long, tapering strongly to a pointed base, 10-12 mm broad at the apex, to 4 mm broad at the base, pallid, blue-grey with blackish dots above the ring; yellow-brown below the ring, and also ornamented with black dots, and at the extreme base with yellow mycelium. Annulus well developed at about the mid portion of the stipe, shining translucent, olive-green, glutinous, rupturing at the stipe, before rupturing at the pileal margin, and rolling up to form a thick, white rim (well shown in Smith (1985) and by Lincoff (1981); later rupturing also at pileal margin, and collapsing on to the stipe, as a broad, adpressed band (not forming a spreading membranous ring). **Flesh** pale olivaceous yellow in pileus, ochre-brown in stipe, and bright ochre-yellow at extreme base of stipe. In older specimens flesh in pileus up to 15mm thick, dirty-cream. No bluing in the cut flesh or on handling. **Cuticle of pileus** of repent, gelatinized, indistinct, hyaline hyphae, permeated by abundant, refractive, oleiferous elements, which are branched, vermiform and with yellowish content, 4.0-6.6 μm d. Hyphae of pileal context lacking clamp-connections and to 20μm d. **Tube trama** regular, of thin-walled, hyaline hyphae, lacking clamp-connections, 3.0-5.0 (6.6) μm d., oleiferous hyphae few. **Hyphae of stipitipellis** of thin-walled, hyaline, parallel hyphae, 3.0-6.6 μm d. and very few oleiferous hyphae. **Glandular dots** on stipe above the annulus, comprising elongated clavate, or subcapitate, rarely subcylindric or fusoid elements, with thin or distinct walls, and appearing hyaline to subhyaline; these elements 50-66 μm long, and 7.5-13.0 μm wide at the apex. **Basida** 16-18 x 6.0-7.0μm, thin-walled, hyaline, 4 spored. **Spores** 7.0-8.2 x 2.75-3.0 μm, brown, boletoid in shape.

In pine forest, Mpumalanga, between Sabie and White River, at the Witklip Dam. Dr Johan Duminy, February 1998. **PRUM** 4730

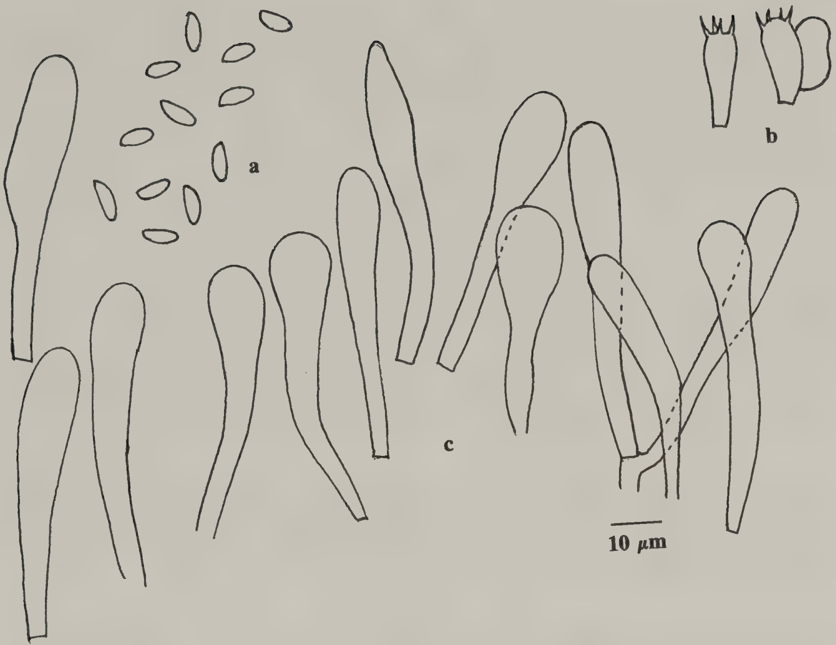
Distribution in South Africa:

Known only from the above collection.

General Distribution:

Suillus salmonicolor is widespread in North America and according to Both (1993) [writing of *Boletus subluteus*] it is found from Quebec and Nova Scotia south to North Carolina, west to Michigan. It is also recorded from Mexico: Garcia & Castillo (1981) as *S. subluteus*; Cappello, S & Cifuetes, J (1982) as *S. cothurnatus* var. *hiemalis*; Laferriere & Gilbertson (1992) as *S. pinorigidus*.

In the Old World *S. salmonicolor* is known to occur in Eastern Asia: Former Soviet Union: Kamchatka (Kalamees & Vaasma, 1981 as *S. subluteus*); Lake Baikal (Nezdojminogo 1973, as *S. subluteus*); Barguzin Mountain Range (Nezdojminogo, 1971, as *S. subluteus*). Eastern Himalayas and Tibet (Wang & Zang, 1983; Zang, 1986, as *S. subluteus*). Taiwan: (Chen, 1987 as *S. subluteus*). Philippine Islands (Watling 1995 as *S. cothurnatus*). Europe : Finland (Engel, 1996 as *S. cothurnatus* var. *hiemalis*).



Figs. 1. a-c. *Suillus salmonicolor.* a. Spores. b. Basidia. c. Elements comprising glandular dots on stipe.

Discussion:

Until Halling (1983) demonstrated that the oldest available epithet for this bolete was *B. salmonicolor* Frost, it had, hitherto, been widely discussed in the literature under the rather appropriate name *S. subluteus* (Peck) Snell. However, Halling (l.c.) lectotypified *B. salmonicolor* by a Frost specimen (No. 3213) in the Pringle Herbarium, University of Vermont, Burlingham, U.S.A., and provided a full account of the microscopic characters of this material. As a result he proposed the transfer of Frost's species to *Suillus* as *S. salmonicolor* (Frost) Halling - a species which he succinctly characterized as viscid with salmon ochraceous colours.

In South Africa *S. salmonicolor* could only be confused with *S. luteus* (L.: Fr.) S.F. Gray. However, the fruit-bodies of these two taxa have a quite different aspect. Fruit-bodies of *S. luteus* are robust to stocky, with a rather stout cylindrical, to slightly clavate stipe, up to 3cm d., while the fruit-bodies of *S. salmonicolor* are less robust, with a proportionately much taller and narrower stipe. The stipe of *S. luteus* is cylindric to clavate and rather stout, while that of *S. salmonicolor* is proportionally tall and narrow, and frequently tapered to a pointed base. Further, the surface of the stipe in *S. luteus* has glandular dots for the most part conspicuously developed above the annulus, while in *S. salmonicolor* the glandular dots are conspicuous throughout the length of the stipe.

The colour of the pileus also differs considerably. In *S. luteus* the pileus is usually dark chestnut-brown or sepia, with a virgate appearance, and sometimes develops a violaceous tint. The pileus of *S. salmonicolor* is altogether paler, more yellowish and varies from salmon ochraceous (Halling 1983) at least when young, to yellowish or yellowish brown, and in age to dingy yellow-brown, with a tendency to develop olive tints, and to become virgate.

The annulus of the two species is also distinctive. In *S. luteus* it ruptures from the margin of the pileus and forms a striking horizontal, membranous ring. By contrast in *S. salmonicolor* the annulus often ruptures from the stipe before tearing away from the pileal margin, with the result that the free edge of the annulus rolls up and forms a thick white rim adjacent to the stipe (well shown in Smith 1963, No 50; Smith & Smith 1985, No 64.) while still attached to the margin of the pileus; the annulus then appearing funnel-shaped. Finally, when rupture occurs at both stipe and pileal margin, the annulus collapses on to the stipe as a broad band. This type of rupturing of the annulus is never observed in *S. luteus*.

There is also a difference in colour of the flesh between *S. luteus* and *S. salmonicolor*. In the former it is virtually white throughout, while in *S. salmonicolor* it is pale yellow to pale orange-yellow, changing in the stem base to yellow-brown or bright ochre-yellow.

Confusion with *Suillus granulatus* (L.: Fr.)O. Kuntze and *S. bovinus* (L.: Fr.)O. Kuntze and *S. bellinii* (Inz.) Watling - the only other members of the genus *Suillus* Micheli ex S.F. Gray occurring in South Africa - should not pose a problem, since these taxa lack an annulus.

S. salmonicolor occurs in association with various species of *Pinus*, with which it no doubt forms a mycorrhizal relationship; 2 -, 3 -, and 5- needled pines have all been cited as associates of this bolete. In North America *S. salmonicolor* has been found growing with *Pinus australis, P. banksiana, P. palustris, P. resinosa, P rigida, P. strobus* and *P. taeda* but this list does not pretend to be exhaustive. In Kamchatka it has been found in association with *P. pumila*, while in the Philippine Islands it occurs with *P. kesiya*.

While there are extensive plantations of various pines in South Africa, there are no native species, and it therefore seems reasonable to assume that *S. salmonicolor* is an exotic species which has been introduced, possibly fairly recently, into South Africa.

Illustrations:

Illustrations of *S. salmonicolor* include the following: Grund, D.W. & Harrison, A.K. (1976) Pl 61 *as G. subluteus*: Lincoff, G.H. (1981) No. 37 as *S. subluteus*; Smith, A.H. (1963) No 50 as S. subluteus; Smith, A.H. & Thiers, H. (1964) Pl. 28 as *S. subluteus*; Smith, A.H. & Thiers, H. (1971) Pl 21 as *S. subluteus*; Snell, W.H. & Dick, E.A. (1970) Pl. 18 as *S. subluteus*; Pl. 19 as *S. pinorigidus*.

Acknowledgements

Financial support from the Foundation for Research Development is gratefully acknowledged. We thank Dr G.C.A. van der Westhuizen for reviewing the manuscript and Dr Roy Halling and Dr Timothy Baroni for helpful advice and discussion.

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Halling, R.E. 1983. Boletes described by Charles C. Frost. *Mycologia* **75**, 70-92.

Kalamees, K. & Vaasma, M. 1981. Macromycetes of Kamchatka 1. *Folia Crypt. Eston*: **16**, 1-8.

La Ferrierè, J.E. & Gilbertson, R.L. 1992. Fungi of Nabogame, Chihuahua, Mexico. *Mycotaxon:* **44**: 73-78.

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Nezdojminogo, E.L. 1971. Mushrooms of High Mountain belts in Bargusin Mountain Range. *Mikol. Fitopat:* **5**: 85.

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Smith, A.H. & Thiers, H.D. 1964. A contribution toward a monograph of North American species of *Suillus*. Ann Arbor. Michigan. Pp 116.

Smith, A.H. & Thiers, H.D. 1971. The Boletes of Michigan, University of Michigan Press. Ann Arbor. Michigan. Pp 316.

Snell, W.H. & Dick, E.A. 1956. Notes on Boletes. IX. *Mycologia* **48**: 302-310.

Snell, W.H. & Dick, E.A. 1970. The Boleti of Northeastern North America. Cramer, Venduz. Pp 116.

Wang, Y-C & Zang, M. 1983. Fungi of Xizhang (Tibet). Science Press. Beijing.

Watling, R. 1995. Putative fungus-tree relationships: What do they tell us? *Doc. Mycol.* **25**: 479 - 486.

Zang, M. 1986. Notes on Boletales from Eastern Himalayas and adjacent areas of China. *Acta Bot. Yunnan.* **8**: 1-22.

MYCOTAXON

Volume LXXIV(1), pp. 83-104 January-March 2000

MYCOLOGICAL LITERATURE RELEVANT TO NEW CALEDONIA

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ABSTRACT: An annotated list of publications relating to fungi of New Caledonia is presented. Over two hundreds titles were retrieved, starting from the year 1845. Interestingly more publications were issued from the start of the new European settlement in 1853 up to the first World War, than for the period between the two World Wars. For the latter only four titles could be located.

Before the first World War, Patouillard from the Paris Museum contributed much to our knowledge of the higher fungi of this island. After 1945, a series of papers of phytopathological interest were successively published by resident specialists such as Dadant, Bugnicourt, Huguenin and finally Köhler and Pellegrin. For the same period, pure taxonomic studies were undertaken by visiting mycologists such as Heim, Horak and Mouchacca.

In comparison to information accumulated on the higher plants of New Caledonia, present knowledge of its fungi is definitely limited.

KEY WORDS: fungi, New Caledonia, documentation, taxonomy, phytopathology

INTRODUCTION

Recent interest in fungi of New Caledonia has resulted in the publication of a series of papers on the island's mycobiota. Information on ascomycetes based on material collected in New Caledonia was summarized by Mouchacca (1998). An updated annotated check-list of holobasidiomycetes reported from New Caledonia was published by Horak & Mouchacca (1998); the list integrates observations reported since the start of the botanical exploration by d'Entrecasteaux in 1793. Mouchacca & Horak (1999) prepared a similar list for rusts and smuts based on specimens kept in the small New Caledonian herbarium. A similar document on reported deuteromycetes is under preparation by Mouchacca & McKenzie. Finally, Elix & McCarthy (1998) produced a document on the distribution of lichens in 33 island groups and isolated islands (including New Caledonia and its dependancies) of the South Pacific region.

A general account on the island's mycological history awaits preparation. Some aspects of this history were provided, however, in the papers focusing on particular taxonomic fungal groups. The present contribution is a continuation of previous work undertaken to critically assess information on the biodiversity of the fungi in New Caledonia. It brings together all available titles published since the establishment of European settlement in the area in 1853. Contents of the papers either concern only New Caledonia and its dependancies, or include information relevant to this island.

TITLES RETRIEVED

All publications retrieved are fully referenced with author's name (s), title, date and place of publication and page numbers. Many are also accompanied by a short descriptive annotation. For papers introducing fungi then considered as being new to science, binomials of the relevant taxa are specified.

Journal titles are abbreviated according to B-P-H/S (Botanico-Periodicum-Huntianum/Supplementum Hunt Institute for Botanical Documentation, Pittsburgh, 1991). Citation of fungal author's names follows Brummit & Powell (1992). In the text, only one abbreviation is introduced; New Caledonia: NC.

AMIR H. & PINEAU R., 1998. Effects of metals on the germination and growth of fungal isolates from New Caledonian ultramafic soils. Soil Biol. Biochem. **30**: 2043-2054.
According to the authors, a higher degree of tolerance to some heavy metal cations characteristic of New Caledonian ultramafic soils could explain the absence of few fungal genera in cultivated soils of this island.

ANONYMOUS, 1952. Current Research in the South Pacific in the field of economic development. South Pacific Commission, Nouméa, Technical Paper No. 29, 82 p.
Provides information on several items of phytopathological interest for the islands of NC and New Hebrides (now Vanuatu). For NC, diseases considered are dry rot of coffee, black rot of cabbage, and collar rot and rapid decay of oranges.

ANONYMOUS, 1954. Phytopathologie - Courrier des Chercheurs de l'Office de la Recherche Scientifique d'Outre-Mer. ORSTOM, Paris **8**: 159-186.
Includes a report by F. Bugnicourt on a new disease of taro plants imported from New Hebrides and grown on the east coast of NC. The causal agent proved to be *Pythium irregulare*. Another report by R. Dadant focuses on infection of *Coffea arabica* by rust, *Hemileia vastatrix* and thread-blight of coconut palms by *Corticium penicillatum*.

ANONYMOUS, 1954. Congrès de la protection des végétaux et de leurs produits sous les climats chauds. (Congress on the protection of plants and their products in hot climates), Marseille, Institut Français d'Outre-Mer (21-25 septembre 1954), 543 p.
F. Bugnicourt (pp. 235-239) presented his list of parasitic fungi of cultivated plants in NC.

BATISTA A.C., BEZZERA J.L, BARROS T.T. & LEAL F.B., 1970. Sôbre un novo gênero de *Microthyriaceae* da Nova Caledônia. Publ. Univ. Recife Inst. Micol. **637**: 1-11.
Protologue of *Vizellopsis grevilleae* gen. nov., sp. nov.

BEZZERA J.L., BARROS T.T. & LEAL F.B., 1970. *Hugueninia*, un nôvo gênero da familia *Microthyriaceae*. Publ. Univ. Recife Inst. Micol. **643**: 1-11.

Diagnosis of *Hugueninia freycinetiae* gen. nov. & sp. nov., dedicated to the phytopathologist B. Huguenin who communicated the described material from NC.

BLANDEAU J., 1911. *Hemileia.* Revue Agricole de la Chambre d'Agriculture de la Nouvelle-Calédonie, octobre 1911, pp. 17-19.

Reports on the first record of this coffee rust in NC.

BOCCAS B., 1983. Etude des *Fusarium* parasites du maïs et des mycotoxines fusariennes en Nouvelle-Calédonie. Compte rendu de première année de recherche CORDET (projet C 78), 6 p.

A preliminary note on the prevalence of *Fusarium moniliforme* on maize grains used for feeding horses.

BOCCAS B., KÖHLER F. & PELLEGRIN F., 1983. *Hemileia vastatrix* and New Caledonia. IVth International Congress of Plant Pathology, Melbourne, September 1983, poster abstract.

Reports on the spread of the disease in relation to the ongoing interest in coffee production in NC.

BOCCAS B., KÖHLER F. & PELLEGRIN F., 1985. Les races physiologiques d'*Hemileia vastatrix* en Nouvelle-Calédonie et à Vanuatu. Café, Cacao, Thé **29**: 177-182.

Urediniospore samples were inoculated onto clones of *Coffea arabica* and three virulence factors were identified in NC but only one in Vanuatu.

BOCCAS B., PELLEGRIN F., KÖHLER F., HAMEURT J., KONGOULEUX J., LAURENT D., DOMENECH J. & STACHURSKI F., 1985. La fusariose du maïs et les mycotoxines fusariennes en Nouvelle-Calédonie. Rapport pour la CORDET sur les recherches effectuées en 1982, 1983, 1984 (projet C 78), 31 p. (technical report).

BOCCAS B., PELLEGRIN F., KÖHLER F. & KONGOULEUX J., 1986. La fusariose du maïs en Nouvelle-Calédonie. Convention ORSTOM-CEE, Rapport du Service de Phytopathologie, Document Centre ORSTOM Nouméa (technical report), 19 p.

A preliminary note on the prevalence of *Fusarium moniliforme* on maize grains used for feeding horses.

BOCCAS B., PELLEGRIN F., KÖHLER F., SEIVERT B. & PILACKI A., 1984. La rouille orangée du caféier Arabica en Nouvelle-Calédonie. 2. Essais de contrôle chimique. Café, Cacao, Thé **28**: 203-208.

Conveys data from field chemical control measures for reducing rust infection.

BOCCAS B., SEIVERT B., PELLEGRIN F. & KÖHLER F., 1981. La rouille orangée du caféier en Nouvelle-Calédonie. Service de Phytopathologie, Document Centre ORSTOM Nouméa (technical report), 32 p.

BOCCAS B., SEIVERT B., PELLEGRIN F. & KÖHLER F., 1981. La rouille orangée du caféier Arabica en Nouvelle-Calédonie. Rapport sur les recherches epidémiologiques et génétiques en 1980. Rapport du Service de Phytopathologie et Direction des Services Ruraux, Document Centre ORSTOM Nouméa (technical report), 70 p.

Hemileia vastatrix on *Coffea arabica.*

BOIDIN J., LANQUETIN P. & MacKEE H.S., 1986. *Vararia rosulenta* (Basidiomycète, Lachnocladiaceae), nouvelle espèce néo-calédonienne. Windahlia **16**: 81-84.

BOOTH C. & SHAW D.E., 1967. *Anthostomella fusispora* sp. nov. and *A. cylindrospora* sp. nov. on *Cocos nucifera.* Papua and New Guinea Agricultural Journal **19**: 94-98.

Reports on the presence in NC of the new ascomycete *Anthostomella cylindrospora* described from material collected in New Guinea.

BOUCARON C., KÖHLER F., MICOLAU E., MORCHOINE C., NANDRIS D. & PELLEGRIN F., 1992. Amélioration phytosanitaire de la culture du maïs en Nouvelle-Calédonie. Rapport CORDET (technical report), 28 p.

Discusses trials to select new varieties of corn resistant to *Fusarium moniliforme* and three rust diseases prevalent in the island.

BRAUN U., MOUCHACCA J. & McKENZIE E.H.C., 1999. Cercosporoid hyphomycetes from New Caledonia and some other South Pacific islands. New Zealand J. Bot. **37**: 297-327.

A taxonomic revision of collected members of this group in the area.

BRESINSKY A. & BINDER M., 1998. *Leratiomyces* nom. nov. für eine bislang nicht gültig beschriebene Gattung der Strophariaceae (Agaricales) aus Neukaledonien. Z. Mykol. **64** : 79-82.

The new name *Leratiomyces* Bresinsky & Binder is proposed for the invalid *Le Ratia* Pat. 1907. New combinations are established for the four known taxa of the genus.

BUGNICOURT F., 1949. Les espèces du genre *Curvularia* isolées des semences de riz. VIIth Pacific International Scientific Congress in Auckland (2-8 February 1949) and Christchurch (16-22 February 1949), New Zealand, Lecture abstract.

Distribution of several *Curvularia* species in rice grains grown in the South Pacific region and Vietnam. F. Bugnicourt spent several years in Vietnam before arriving in NC (see Mouchacca, 1997).

BUGNICOURT F., 1950. Les espèces du genre *Curvularia* isolées des semences de riz. Rev. Gén. Bot. **57**: 65-77.

Provides frequencies of occurrences of five *Curvularia* species on rice grains grown in Vietnam and in the South Pacific. Only *Curvularia lunata* was detected on samples from NC with *C. oryzae* and *C. uncinula* proposed as new species.

BUGNICOURT F., 1950. Sur une méthode de contamination artificielle. Son application pour la recherche d'arbres résistants à certaines maladies cryptogamiques. Rev. Gén. Bot. **57**: 157-167.

A method is described for testing the resistance of trees to fungal diseases. It was first applied in Vietnam then in NC for testing Robusta coffee trees against a species of *Thielaviopsis* recently observed to cause a typical hadromycosis.

BUGNICOURT F., 1951. Mycoflore des semences du riz. In 'Conférence Phytosanitaire du Pacifique Sud, Suva, Fidji (2-11 avril 1951)'. Rapport de la Conférence sur la Quarantaine Végétale et Animale, Suva, Fidji, avril 1951. Commission du Pacifique Sud, Nouméa, Rapport Technique No. 9, 5 p.

Considers fungi observed on rice grains grown in several islands in the area.

BUGNICOURT F., 1952. Note sur la mycoflore des semences de riz dans les territoires du Pacifique Sud. Rev. Mycol. (Supplément Colonial) **17**: 26-29.

Reports on the occurrence of 20 different species of fungi on rice seeds from the Fiji Islands, NC, Dutch New Guinea, Tahiti, Hawaiian Islands and Australia.

BUGNICOURT F., 1952. Note on the mycoflora of rice seed in the territories of the South Pacific Commission. South Pacific Commission, Nouméa, Technical Paper No. 21, 5 p.

An English translation of the previous publication.

BUGNICOURT F., 1952. Une espèce fusarienne nouvelle, parasite du riz. Rev. Gén. Bot. **59**: 13-18.

Rice grains grown by the dry culture technique in NC were affected by *Fusarium annulatum* sp. nov.

BUGNICOURT F., 1952. Contribution à l'étude systématique de deux micromycètes parasites du riz. Rev. Gén. Bot. **59**: 413-420.
Details the distribution of *Trichoconis padwickii* and *Helicoceras oryzii* on rice in Vietnam and the South Pacific.

BUGNICOURT F., 1954. Champignons parasites des plantes cultivées en Nouvelle-Calédonie. In 'Congrés de la protection des végétaux et de leurs produits sous les climats chauds (21-24 septembre 1954)'. Institut Français d'Outre-Mer, Marseille, pp. 235-239.
The author introduced his first list of parasitic fungi of cultivated plants in NC.

BUGNICOURT F., 1955. Deux espèces nouvelles d'*Helminthosporium* isolées de semences du riz. Rev. Gén. Bot. **62**: 238-243.
Two new species of *Helminthosporium* occurring in rice grain in the South Pacific region are described but without a Latin diagnosis: *H. hawaiiense* and *H. australiense*; both were later recorded in NC.

BUGNICOURT F., 1956. Champignons parasites de plantes cultivées en Nouvelle-Calédonie. Institut Français d'Océanie, ORSTOM, Nouméa, 23 p.
An elaborate list of diseases of economic importance prepared on the fungal and on a host base.

BUGNICOURT F., 1958. Sur une maladie du maïs. Revue Agricole de la Nouvelle-Calédonie, **9** (Nos. 10-12, octobre-novembre), pp. 1-5.
Maize grains grown in NC were found to be infected by *Fusarium moniliforme* and *F. graminearum*.

BUGNICOURT F., 1958. Contribution à l'étude de *Cladosporium colocasiae* Sawada. Rev. Mycol. **23**: 233-236.
In NC the fungus is frequently present in plantings of *Colocasia antiquorum* where it produces a foliar disease.

BUGNICOURT F., COHIC F. & DADANT R., 1951. Catalogue des parasites animaux et végétaux des plantes cultivées de Nouvelle-Calédonie. Institut Français d'Océanie, ORSTOM, Nouméa, 120 p.
A serious attempt to produce a catalogue listing the principal plant and animal parasites of cultivated plants in NC with information on incidence and economic importance.

BUGNICOURT F. & MARTY J., 1961. Champignons parasites des plantes cultivées en Nouvelle-Calédonie. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa, Imprimerie Nouvelle D. Tardieu, 20 p.
This list includes a host index (102 species) and a list of 183 pathogenic fungi.

COMBES R., 1952. Exposé des activités de l'Office de la Recherche Scientifique d'Outre-Mer pour les années 1946-1949-1950. ORSTOM, Paris, 71 p.
For NC this report discusses the recent achievements of the plant pathological laboratory at the Institut Français d'Océanie in Nouméa: presents a preliminary list of crop diseases, outlines methods of growing better crops and controlling diseases. The activities of the new local consultative epidemic committee are also reviewed.

COOKE M.C., 1887. Australasian Fungi. Grevillea **16**: 30-33.
Protologue of *Agaricus (Lepiota) echinodermatus*.

CRIÉ L., 1874. Sur une altération pathologique des feuilles de l'*Ionidium austrocaledonicum* Vieill. J. Pharm. Chim., sér. **IV**, **19**: 113-114.

Reports the presence of *Septoria chatiniana* sp. nov. on plant material collected by Vieillard and maintained in the Paris Museum. Dedicated to M. Chatin, then director of the 'Ecole Supérieure de Pharmacie de Paris'.

CRIÉ L., 1874. Coup d'oeil sur la végétation fongine de la Nouvelle-Calédonie. Bull. Soc. Linn. Normandie **8**: 442-451.

A review of the then available information on NC fungi extended with the author's observations from his examination of original plant material. Includes the protologue of *Rhytisma austro-caledonicum.*

CRIÉ L., 1878. Recherches sur les Dépazées. Ann. Sci. Nat., sér. **VI**, Botanique 7: 5-60.

In this thesis memoir the author reviews current knowledge on known species of *Depazea*; proposal of *D. australis* sp. nov. observed on plant material from NC.

CRIÉ L., 1879. Sur les Pyrénomycètes inférieurs de la Nouvelle-Calédonie. Compt. Rend. Hebd. Séances Acad. Sci., Paris, sér. **I, 89**: 994-995.

A report on several fungi observed on plant material from NC in the Paris Museum. Refers to his earlier proposal of *Depazea australis* and briefly introduces the new taxa *Phoma eugeniarum* (on leaves of *Eugenia* sp.), *Pestalozzia austro-caledonicum* and *Phyllosticta apiculatum* (on leaves of *Caesalpinea* sp.).

As indicated by Mouchacca (1998), Crié made no attempt to segregate material of the fungi he proposed as new from the plant specimens scanned at the Paris Museum. So annotations by Crié on relevant plant sheets should be studied for type material retreival.

DADANT R., 1950. La défense des couches à semis des cultures maraîchères contre la 'fonte de semis' en Nouvelle-Calédonie. Revue Agricole de la Nouvelle-Calédonie, N. S., **1** (Nos. 3-4, mars-avril), pp. 4-5.

A note for market growers of damping-off diseases of seedlings.

DADANT R., 1950. Premiers principes de lutte contre les maladies des pommes de terre. Revue Agricole de la Nouvelle-Calédonie, N. S., **1** (Nos. 5-6, mai-juin), pp. 7-8.

A popular note on control measures for fungal and other diseases of potatoes.

DADANT R., 1950. Au sujet de la maladie du Black-rot des choux. Revue Agricole de la Nouvelle-Calédonie, N. S., **1** (Nos. 9-10, septembre-octobre), pp. 13-14.

A popular note on this cabbage black-rot disease.

DADANT R., 1950. Sur une nouvelle maladie du *Coffea robusta* en Nouvelle-Calédonie. Rev. Gén. Bot. **57**: 168-167.

Robusta coffee in NC is affected by a fungus disease leading to death of the tree. The fungus belongs to the genus *Thielaviopsis* and following the author 'if it should prove to be a new species, the name *T. neocaledoniae* could be selected'. The hyphomycete was later renamed *Chalara neocaledoniae* (see Kiffer & Delon, 1983).

DADANT R., 1952. Sur deux maladies des caféiers. Revue Agricole de la Nouvelle-Calédonie, **3** (Nos. 1-2, janvier-février), pp. 4-5.

Conveys information on two fungal diseases of local coffee trees induced by *Ustulina zonata* and a dematiaceous hyphomycete for which the invalidly published binomial *Thielaviopsis neocaledoniae* was proposed.

DADANT R., 1952. Un moyen pratique de lutte contre l'*Oidium* des melons. Revue Agricole de la Nouvelle-Calédonie **3** (Nos. 3-4, mars-avril), pp. 4-5.

Control measures against *Oidium erysiphoides* infecting melons. This *Oidium* is now regarded as a *nom. amb*. (Braun, 1995). *Erysiphe polygoni* and *Sphaerotheca*

fuliginea are actually commonly encountered on melons in NC (see Kohler & Pellegrin, 1992).

DADANT R., 1953. Contribution à l'étude de *Oospora citri-aurantii* Ferraris, parasite des agrumes en Nouvelle-Calédonie. Rev. Pathol. Vég. Entomol. Agric. France **32**: 87-92.

Reports on the severe economic losses due to the rotting of citrus fruits by this fungus following skin puntures caused by insects. According to Braun (1995), the cited binomial does not represent a powdery mildew. It is not reported by Kohler & Pellegrin (1992).

DADANT R., 1953. *Corticium penicillatum* Petch, Thread blight du cocotier. Rev. Mycol., Supplément Colonial **18**: 1-4.

A descriptive sheet of the parasite and problems induced in the South Pacific region.

DADANT R., 1954. Le caféier en Nouvelle-Calédonie, ses maladies. Agron. Trop. (Nogent-sur-Marne) **9**: 49-58.

Reviews coffee diseases (mainly Arabica and Robusta) of fungal origin or resulting from physiological disorders.

DADANT R., 1955. Une maladie du Taro en Nouvelle-Calédonie. Atti del VI Congresso Internazionale di Microbiologia, Roma, 6-12 September 1953, vol. 5, Session No. 14, pp. 250-257.

Discusses the history, epidemiology and control measures of a new disease of taro imported with plants from New Hebrides. The causal agent is described as *Pythium irregulare* var. *neocaledonica*, var. nov. but without a Latin diagnosis. The status of the variety was not re-assessed in the relevant monograph by Plaats-Niterink (1981).

DESJARDIN D.E. & HORAK E., 1997. *Marasmius* and *Gloiocephala* in the South Pacific Region: Papua New Guinea, New Caledonia, and New Zealand taxa. Bibl. Mycol. **168**: 1-83.

For NC protologues of *Marasmius aurantiobasalis* var. *hispidipes* and *M. ochroleucus* and new records of *M. pellucidus*, *M. amabilis* and *M. elatus*.

DOMENECH J., 1982. Etude d'un foyer de leucoencéphalomacie du cheval en Nouvelle-Calédonie. Rapport IEMVT (technical report), 6 p.

First mention of an equine leucoencephalomalacy due to a mycotoxicosis.

DOMENECH J., BOCCAS B., PELLEGRIN F., LAURENT D., KÖHLER F., MAGNOL J. & LAMBERT C., 1984. Etude de la fusariose du maïs à *Fusarium moniliforme* en Nouvelle-Calédonie et de la pathologie equine associée à la leucoencephalomalacie toxique. Rev. Elev. Méd. vét. Pays trop. **37**: 253-259.

Reports on cases of this mycotoxicosis and sources of maize infection in NC.

DOMENECH J., BOCCAS B., PELLEGRIN F., LAURENT D., KÖHLER F., MAGNOL J. & LAMBERT C., 1985. Equine leukoencephalomalacia in New Caledonia. Austral. Veterin. J. **62**: 422-423.

A short account of the distribution of this mycotoxicosis in NC.

DOMENECH J., BREGEAT D. & BOCCAS B., 1982. Les mycotoxicoses en pathologie animale : intérêt de leur étude en Nouvelle-Calédonie. Revue d'Elevage et de Médecine Vétérinaire de Nouvelle-Calédonie **1**: 11-18.

A review for local farmers on the various aspects of animal mycotoxicoses.

DUMBLETON L .J., 1954. A list of plant diseases recorded in South Pacific Territories. South Pacific Commission, Nouméa, New Caledonia, Technical Paper No. 78, 78 p. (a French translation is available).

This useful list of parasites (including viruses) and hosts includes the territories in which they have been recorded. The bibliography contains several titles for NC.

DUSSERT P., 1911. Semences de caféiers réfractaires à *Hemileia*. Revue Agricole de la Chambre d'Agriculture de la Nouvelle-Calédonie, novembre 1911, pp. 17-20.

ELIX J.A. & McCARTHY P.M., 1998. Catalogue of the Lichens of the Smaller Pacific Islands. Bibl. Lichen. **70**: 1-361.
Check-list of lichens are presented for each island group and isolated islands including NC and its dependancies.

FIRMAN I.D., 1975. Annotated bibliography of sources of information on plant disease distribution in the area of the South Pacific Commission. South Pacific Commission, Nouméa, New Caledonia, Technical Paper No. 172, 23 p.
This host list is based on Dumbleton's list; it attempts to include and reconcile information from other disease reports. The bibliogrpahy contains references for NC.
FIRMAN I. D., 1978. Plant pathology in the region served by the South Pacific Commision. Rev. Pl. Pathol. **57**: 85-90.
After an introduction this review considers plant pathology at the regional and national levels, early records of fungi and diseases, lists of diseases, work on the main crop plants and quarantine regulations.
FIRMAN I. D., 1978. Bibliography of plant pathology and mycology in the area of the South Pacific Commission 1820-1976. South Pacific Commission, Technical Paper No. 176, 78 p.
An extended annotated list of titles dealing with plant pathology in the area.
FRAYSSE A., 1911. L'*Hemileia vastatrix* à Ponérihouen. Revue Agricole de la Chambre d'Agriculture de la Nouvelle-Calédonie, juin 1911, pp. 3-12.
Reports the development of coffee rust in this part of NC. The author was then Secretary of the Agricultural Chamber in NC. A specimen of rusted coffee from Ponérihouen dated 1909 is present in the 'Herb. Station Centrale de Pathologie Végétale de Versailles' now lodged in PC.

GUZMAN G. & HORAK E., 1978. New species of *Psilocybe* from Papua New Guinea, New Caledonia and New Zealand. Sydowia **31**: 44-54.
Protologue of *Psilocybe neocaledonica*. The record of this fungus in NC was not reported by Horak & Mouchacca (1998).

HANSFORD C. G., 1958. A new species of *Amazonia*. Kew Bull. **1957**: 410.
Amazonia novae-caledoniae sp. nov., on plant material at the Royal Botanic Gardens.
HARIOT P. & PATOUILLARD N., 1903. Quelques Champignons de la Nouvelle-Calédonie, de la collection du Muséum. J. Bot. (Morot) **17**: 6-15.
The paper deals with 84 taxa identified from specimens collected by Bernier, former Curator of the Musée de Nouméa. 13 proved to be new species: *Daldinia cognata*, *Geoglossum* (*Eugeoglossum*) *noumeanum*, *Hypoxylon neocaledonicum*, *Kretzschmaria scruposa*, *Xylaria corrugata*; *Ganoderma insulare*, *Lentinus araucariae*, *Leucoporus asperulus*, *Marasmius amabilis*, *Polysaccum pusillum*, *Stereum neocaledonicum*, *Trametes aratoides* and *Xanthochrous bernieri*.
HEIM R., 1936. Aperçu sur les Champignons toxiques et comestibles des Colonies Françaises. In 'Pathologie Exotique Vétérinaire et Comparée III.' G. Curasson éd., pp. 1-31 (Vigot Fres. : Paris Imp. G. Thane, Liège).
Includes information on most of the basidiomycetes earlier recorded in these colonies.

HEIM R., 1951. Notes sur la flore mycologique des terres du Pacifique Sud. IV. Le genre néo-calédonien *Le Ratia* Pat. Rev. Mycol. **16**: 154-158.

A modern description of *Leratia similis* based on fresh specimens collected by Dadant and handed to the author while revisiting the island after the 1949 Pacific Science Congress in Christchurch, New Zealand.

HEIM R., 1951. Les champignons luminescents de l'Océanie. Compt. Rend. Hebd. Séances Acad. Sci., Paris **233**: 8-11.

Reports on the collection during his 1949 visit to NC of bioluminescent specimens of *Mycena rorida* var. *lamprospora*, *M. illuminans*, *Poromycena decipiens*, *P. manipularis* and a *Pleurotus* sp. The records of these taxa in NC were not reported by Horak & Mouchacca (1998).

HEIM R., 1965. Les Meioorganés, phylum reliant les Bolets aux Polypores. Compt. Rend. Hebd. Séances Acad. Sci., Paris **261**: 1717-1720.

Introduces the new genus *Meiorganum* based on material collected in NC; the proposed type species *M. neocaledonicum* is not described in this paper.

HEIM R., 1965. Les Meioorganés, phylum reliant les Bolets aux Polypores. Rev. Mycol. **30**: 307-329.

The description of the type species *Meiorganum neocaledonicum* sp. nov. is not accompanied by a Latin diagnosis.

HEIM R., 1966. Quelques Ascomycètes remarquables V. Morilles tropicales (Pacifique Sud). Bull. Trimestriel Soc. Mycol. France **82**: 442-449.

The new *Morchella anteridiformis* is introduced without a Latin diagnosis.

HEIM R., 1966. *Breves diagnoses latinae novitatum genericorum* (2ème série). Rev. Mycol. **31**: 150-159.

Latin diagnoses of *Morchella anteridiformis* and *Meiorganum neocaledonicum*.

HEIM R. 1967. Notes sur la flore mycologique des terres du Pacifique Sud. V. Une Russule à spores échinulées. Rev. Mycol. **32**: 3-11.

Introduces *Russula echinospora* sp. nov. but without a Latin diagnosis.

HEIM R., 1967. Les enigmes des *Le Ratia*. Rev. Mycol. **32**: 11-15.

Debates the phylogeny of the genus based on observations of fresh material of accepted species.

HEIM R., 1967. *Breves diagnoses latinae novitatum genericorum specificarumque nuper descriptorum*. Rev. Mycol. **32**: 203-210.

Includes a Latin diagnosis of *Russula echinospora.*

HEIM R., 1968. Notes sur la flore mycologique des terres du Pacifique Sud. VIII. Nouvelles recherches sur les *Le Ratia* Pat. Rev. Mycol. **33**: 137-154.

Reports observations derived from the first living cultures prepared for two members of the genus. Also includes a description of *Leratia atrovirens* sp. nov. but proposed without a Latin diagnosis.

HEIM R., 1968. *Breves diagnoses latinae novitatum genericorum specificarumque nuper descriptorum.* 4ème série. Rev. Mycol. **33**: 211-217.

Inludes a Latin diagnosis of *Leratia atrovirens.*

HEIM R. & PERREAU J., 1963. Le genre *Boletellus* à Madagascar et en Nouvelle-Calédonie. Rev. Mycol. **28**: 191-199.

Reports on a collection of *Boletellus ananas* made by R. Heim in NC in 1949.

HENNINGS P., 1903. *Squamotubera* P. Henn. gen. nov. *Xylariacearum*. Hedwigia **42**: 308-309.

Squamotubera leratii gen. nov. & sp. nov. is based on material sent by A.J. Le Rat.

HORAK E., 1973. *Entoloma* (Agaricales) in Indomalaya and Australasia. Beih. Nova Hedwigia **43**: 1-352.

Protologue of *Entoloma aromaticum.*

HORAK E., 1977. *Crepidotus episphaeria* and related species from the southern hemisphere. Ber. Schweiz. Bot. Ges. **87**: 227-235.

Descriptions of two new *Crepidotus* species from NC: *C. aureus* and *C. hirsutellus.*

HORAK E., 1978. *Mycena rorida* (Fr.) Quél. and related species from the southern hemisphere. Ber. Schweiz. Bot. Ges. **88**: 20-29.

Proposal of *Mycena irritans* sp. nov.

HORAK E., 1979. Paxilloid Agaricales in Australasia. Sydowia **32**: 154-166.

Protologue of *Paxillus chalybaeus.*

HORAK E., 1980. *Entoloma* (Agaricales) in Indomalaya and Australasia. Beih. Nova Hedwigia **65**: 1-352.

For NC the following new taxa are proposed: *Claudopus miraculosus*, *Entoloma canobrunnescens*, *E. extraordinarium*, *E. floccosodentatum*, *E. glaucopus*, *E. neocaledonicum*, *E. proprium*, *E. rotundisporum* and *E. translucidum.*

HORAK E., 1980. New and remarkable Hymenomycetes from tropical forests in Indonesia (Java) and Australasia. Sydowia **33**: 39-63.

The following new taxa from NC are introduced: *Boletus perroseus*, *B. phytolaccae*, *Cuphocybe ferruginea* and *Lepiota atrata.*

HORAK E., 1981. Notes on taxonomy and biogeography of *Rozites* Karsten. Sydowia **34**: 94-108.

Introduces *Rozites neocaledonica* sp. nov.

HORAK E., 1983. Mycogeography in the South Pacific Region: Agaricales and Boletales. In 'Pacific Mycogeography: a preliminary approach'. Eds. K.A. Pirozynski & J. Walker. Austral. J. Bot., Suppl. Ser. No. 10, pp. 1-41.

Reviews known distribution of basidiomycetous taxa in the area.

HORAK E. & MOUCHACCA J., 1998. Annotated check-list of New Caledonian Basidiomycota. I. Holobasidiomycetes. Mycotaxon **68**: 75-129.

Contains basic descriptive and taxonomic information on over three hundred taxa collected in NC and its dependancies (with fewer from French Polynesia or Samoa); almost one third were collected for the first time in this island. A state of the art document on these fungi for the area.

HORAK E. & WOOD A. E., 1990. Fr. (Agaricales) in Australasia. I. Subgen. *Myxacium* and subgen. *Paramyxacium*. Sydowia **42**: 88-168.

Proposal of the following new taxa collected in NC: *Cortinarius (Myxacium) necessarius*, *C. neocaledonicus* and *C. verecundus.*

HUGUENIN B., 1964. Micromycètes du Pacifique Sud (1re Contribution). Parasites foliicoles des *Pandanus.* Bull. Trimestriel Soc. Mycol. France **80**: 172-185. Protologues of new taxa inducing foliar diseases of *Pandanus tectorius* in the South Pacific area: *Microcyclus pandani*, *Oxydothis pandani*, *Parastigmatea pandani* and *Diplococcium pandani.*

HUGUENIN B., 1964. Micromycètes du Pacifique Sud (2ème Contribution). Une affection tumorale du Niaouli. Rev. Mycol. **29**: 259-266.

Description and symptoms induced by the new ascomycete *Pleomassaria melaleucae* and its anamorph developing on swellings of *Melaleuca leucodendron* in NC.

HUGUENIN B., 1965. Micromycètes du Pacifique Sud. III. Dématiées de Nouvelle-Calédonie. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 11 p.

HUGUENIN B., 1965. Une méthode de lutte contre le pourridié des Caféiers en Nouvelle-Calédonie. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 11 p.

HUGUENIN B., 1965. La pourriture radiculaire des *Xanthosoma sagittifolium* (L.) Schott. causée par *Pythium irregulare* Buisman var. *neocaledenica* Dadant, Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 70 p.

HUGUENIN B., 1965. Rapport de participation aux travaux de la 5ème réunion du Comité Phytosanitaire de la F.A.O. pour la région du S.E. Asiatique et du Pacifique, Canberra, Australie, 26 novembre - 2 décembre 1964. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 17 p.

HUGUENIN B., 1965. Micromycètes du Pacifique Sud (3ème Contribution). (1). Dématiées de Nouvelle-Calédonie. Bull. Trimestriel Soc. Mycol. France **81**: 686-698.

Protologues of new dematiaceous fungi in relation to some plant diseases: *Cercospora alphitoniae*, *Stenella tristaniae*, *Stenellopsis fagraeae* gen. nov. & sp. nov., *Stemphylium xanthosomae* and *Bipolaris xanthosomae*.

HUGUENIN B., 1965. Micromycètes du Pacifique Sud (4ème Contribution). (1) Deux Ascomycètes de Nouvelle-Calédonie. Bull. Trimestriel Soc. Mycol. France **81**: 699-703.

Protologues of two ascomycetes isolated from plant material: *Herpotrichia erythrinae* and *Thielavia neocaledoniensis*; the latter will later on be the type species of the new genus *Isia* D.Hawksw. & Manoharachary.

HUGUENIN B., 1965. Micromycètes du Pacifique Sud. V. Urédinales de Nouvelle-Calédonie. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 15 p.

HUGUENIN B., 1965. Micromycètes de Nouvelle-Calédonie. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 20 p.

HUGUENIN B., 1966. Micromycètes de Nouvelle-Calédonie. Cahiers ORSTOM, Série Biologie **1**: 61-91.

The list provides records of 425 species isolated in culture. Fungi reported belong to 215 genera developing on 182 host-plants or on other substrates. They are either new for NC or previously quoted in former lists of parasitic fungi of cultivated plants or in the relevant preliminary technical reports on the same subject.

HUGUENIN B., 1966. Micromycètes du Pacifique Sud (5ème Contribution). Uredinales de Nouvelle-Calédonie (I). Bull. Trimestriel Soc. Mycol. France **82**: 248-273.

A total of 46 rust species are considered. *Dicheirina vienottii* and *Ravenalia neocaledoniensis* are new species. Modern descriptions of 8 other rusts are also included.

HUGUENIN B., 1967. Microfungi of New Caledonia. F. A. O. Plant Protection Commission, Technical Document No. 57, 8 p.

An enlarged copy of a similar paper published a year before.

HUGUENIN B., (1967) 1968. Micromycètes du Pacifique Sud (6ème Contribution). Uredinales de Nouvelle-Calédonie (2). Bull. Trimestriel Soc. Mycol. France **83**: 941-951.

Reports on 8 Uredinales recorded for the first time in NC. Three new *Puccinia* are established: *P. lifuensis*, *P. montisfontium* and *P. thiensis*.

HUGUENIN B., 1967. Note bibliographique sur les nodules mycorrhiziens des *Podocarpacées*. Laboratoire de Phytopathologie, Centre ORSTOM, Nouméa (technical report), 12 p.

HUGUENIN B., 1968. Les nodules mycorrhiziens du *Casuarina deplancheana* de Nouvelle-Calédonie. Laboratoire de Phytopathologie, Centre ORSTOM, Nouméa (technical report), 33 p.

HUGUENIN B., 1968. Les complexes mycorrhiziens endotrophes du *Casuarina deplancheana*. Premiers résultats des études phénologiques faites au cours des années 1967-68. Laboratoire de Phytopathologie, Centre ORSTOM, Nouméa (technical report), 14 p.

HUGUENIN B., 1969. Micromycètes du Pacifique Sud. (7ème Contribution). Meliolinées de Nouvelle-Calédonie. Rev. Mycol. **34**: 23-61.
The first contribution on NC Meliolinae. 25 new species or varieties are described with records of 17 other species known from Australian, Indo-malaysian and Pacific mycofloras. New taxa are: *Amazonia geniostomatis*, *A. pancheriae*, *Asteridiella melaleucae*, *A. schmidii*, *Meliola albizziae-granulosae*, *M. alstoniae-comptonii*, *M. alyxiicola*, *M. calpidiae*, *M. choryzandrae*, *M. codiae*, *M. comptonellae*, *M. couthoviae*, *M. dognyensis*, *M. dysoxyli-nitidi*, *M. dysoxyli-nitidi* var. *minor*, *M. grevillae-gilivrayi*, *M. kisubiensis* var. *acronychiae*, *M. montisfontium*, *M. mouensis*, *M. nothofagi*, *M. osmanthi-cymosi*, *M. oxerae*, *M. stenocarpi*, *M. tieghemopanacis* and *M. venezuelana* var. *neocaledonica*.

HUGUENIN B., 1969. Micromycètes du Pacifique Sud (8ème Contribution). Ascomycètes de Nouvelle-Calédonie (II). Cah. Pacifique **13**: 295-308.
Mainly fungi from NC: *Microcyclus niaouli* sp. nov., records of two species of *Corynelia* and descriptions of five new species of *Caliciopsis*: *C. myrticola*, *C. podocarpi*, *C. rapanae*, *C. veillonii* and *C. xanthostomatis*.

HUGUENIN B., 1969. Les nodules mycorhiziens du *Casuarina deplancheana* de Nouvelle-Calédonie. Thèse de 3ème cycle, Biologie Végétale, Faculté des Sciences, Université de Rouen, 62 p.

HUGUENIN B. & KÖHLER F., 1969. Quelques Myxomycètes de Nouvelle-Calédonie. Bull. Trimestriel Soc. Mycol. France 85: 381-383.
24 species listed, most being reported for the first time from NC.

HUGHES S.J., 1993. *Meliolina* and its excluded species. Mycol. Pap. **166**: 1-255.
Protologue of *Meliolina novae-caledoniae* based on an incorrectly identified specimen of *Meliola cladotricha* from NC, and a record of *Meliolina degeneri*.

IRAT. Rapport Annuel, 1983. Institut des Recherches Agronomiques Tropicales et des Cultures Vivrières, Nogent-sur-Marne, France, 295 p.
Accounts are given on work done among others on fungus diseases of *Xanthosoma sagittifolium* in NC.

JOHNSON T.W. Jr, 1950. A study of one isolate of *Brevilegnia* from New Caledonia. Mycologia **42**: 242-252.
Protologue of *Brevilegnia longicaulis* from soil samples sent by Prof. J.T. Buchholz.

KIFFER E. & DELON R., 1983. *Chalara elegans* (: *Thielaviopsis basicola*) and allied species. II. Validation of two taxa. Mycotaxon **18**: 165-174.
Chalara neocaledoniae is proposed for the invalidly published *Thielaviopsis neocaledoniae*, agent of a coffee disease in NC; similar symptoms were also observed there on *Psidium guayava*.

KÖHLER F., 1984. Encyclopédie de la Nouvelle-Calédonie. Tome 3. Faune et Flore Terrestres. Les Champignons, pp. 130-140. Neto Diffusion, Nouméa.

KÖHLER F., 1985. Agents pathogènes et maladies physiologiques des plantes cultivées en Nouvelle-Calédonie et aux Iles Wallis et Futuna. Laboratoire de Phytopathologie, Centre ORSTOM, Nouméa (technical report), 46 p.

A list of pathogens inducing diseases of garden, nursery and fruit plants, cereals and fodder plants, ornamentals and trees.

KÖHLER F., 1987. Agents pathogènes et maladies physiologiques des plantes cultivées en Nouvelle-Calédonie et aux Iles Wallis et Futuna. Catalogues Sciences de la Vie, Phytopathologie No. 1, Institut Français de Recherche Scientifique pour le Développement en Coopération ORSTOM, Centre de Nouméa, Nouvelle-Calédonie, 48 p.

An update of the previous lists of fungi parasitic on cultivated plants on these islands. Almost 300 taxa developing on 130 hosts are indexed.

KÖHLER F. & PELLEGRIN F., 1992. Pathologie des végétaux cultivés. Nouvelle-Calédonie, Polynésie Française et Wallis et Futuna. Editions de l'ORSTOM, Collections Didactiques, Paris, 171 p.

A popular, richly illustrated book with coloured photographs of many diseases of cultivated plants to be found in the Pacific French territories.

KÖHLER F., PELLEGRIN F., JACKSON G. & McKENZIE E., 1997. Diseases of Cultivated Plants in Pacific Island Countries. South Pacific Commission, Nouméa, New Caledonia, 186 p.

A comprehensive expanded English version of the former French edition published by the first two authors.

KÖHLER F., PELLEGRIN F. & LAURENT D., 1988. La toxicogenèse chez *Fusarium moniliforme* : nouvelles observations. Microbiol. Alim. Nut. **6**: 165-169.

Recent development of this *Fusarium* mycotoxicosis in NC.

LAMOUROUX N., PELLEGRIN F., NANDRIS D. & KÖHLER F., 1995. The *Coffea arabica* fungal pathosystem in New Caledonia: Interactions at two different spacial scales. J. Phytopath. **143**: 403-403.

Biometrical studies of the development of rust disease in coffee plantations.

LAURENT D., GOASDOUE N., KÖHLER F., PELLEGRIN F. & PLATZER N., 1990. Caracterisation of cyclonerodiol from corn infested by *Fusarium moniliforme* Sheld.: one and two dimensional 1H and 13C N.M.R. study. Magnetic Resonance Chemistry **28**: 662.

LAURENT D., LANSON M., GOASDOUE N., KÖHLER F., PELLEGRIN F. & PLATZER N., 1990. Etude au R.M.N. 1H et 13C de la macrofusine, toxine isolée de maïs infesté par *Fusarium moniliforme* Sheld. Analusis **18**: 172-179.

LAURENT D., PELLEGRIN F., KÖHLER F., FOUQUET L., LAMBERT C. & BOCCAS B., 1988. *Fusarium moniliforme* du maïs en Nouvelle-Calédonie : Toxicologie animale. Microbiol. Alim. Nut. **6**: 159-164.

Evaluation of toxinogenic levels of strains of this *Fusarium* species isolated from locally infected fodder corn.

LAURENT D., PELLEGRIN F., KÖHLER F., COSTA R., THEVENON J. & HUERRE M., 1989. La fumonisine B1 dans la pathogènie de la leucoencéphalomalacie equine. Microbiol. Alim. Nut. **7**: 285-291.

Caracterisation of a new toxin (fumonisine B1) isolated from *Fusarium moniliforme*.

LAURENT D., PELLEGRIN F., KÖHLER F., COSTA R., THEVENON J., DEMERSEMAN P., GUILLAUMEL J. & PLATZER N., 1992. Is Fumonisin B1 responsible for equine leucoencephalomalacia ? Xth World Congress on Animal, Plant and Microbial Toxins, Singapore, ABSTRACT, November 3-8, 1991. Toxicon **30**: 530.

LAURENT D., PELLEGRIN F., KÖHLER F., LAMBERT C., HAMEURT J., BOCCAS B. & DOMENECH J., 1887. Toxicité aigüe sur canetons Pékin de souches de *Fusarium moniliforme* isolées de maïs en Nouvelle-Calédonie. Microbiol. Alim. Nut. **5**: 11-15.

Toxicological studies of *F. moniliforme* strains isolated from locally infected corn.

LAURENT D., PLATZER N., KÖHLER F., SAUVIAT P. & PELLEGRIN F., 1989. Macrofusine et micromoniline : deux nouvelles mycotoxines isolées de maïs infesté par *Fusarium moniliforme* Sheld. Microbiol. Alim. Nut. **7**: 9-16.

Reports the isolation of two novel molecules from cultures of *Fusarium moniliforme* isolated from mouldy fodder corn in NC.

LEVEILLE J. H., 1845. Champignons exotiques. Ann. Sci. Nat. (Paris), sér. **III**, Botanique, **3**: 58-60.

Protologue of *Depazea celastrina.*

MAAS GEESTERANUS R.A. & HORAK E., 1995. *Mycena* and related genera from Papua New Guinea and New Caledonia. Bibl. Mycol. **159**: 143-229.

Introduces the following new taxa from NC: *Filoboletus conus*, *F. pustulosus*, *Mycena odora* and *M. rubidolimbata.*

MARTY J., 1958. Maladies cryptogamiques observées à l'Ecole d'Agriculture de Port-Laguerre. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 12 p.

MARTY J., 1958 Rapport d'une mission phytopathologique à Lifou (Iles Loyauté), 2-9 décembre 1956. Laboratoire de Phytopathologie, Institut Français d'Océanie, ORSTOM, Nouméa (technical report), 20 p.

List of the pathogens of cultivated plants in Lifou island, NC.

McKENZIE E.H.C., 1991. Dematiaceous Hyphomycetes on *Freycinetia* (*Pandanaceae*) 1. *Stachybotrys*. Mycotaxon **41**: 179-188.

Protologue of *Stachybotrys breviusculus* and record of *S. parvispora*, both from NC.

McKENZIE E.H.C., 1991. Dematiaceous Hyphomycetes on *Freycinetia* (*Pandanaceae*) 2. *Zebrospora* gen. nov. Mycotaxon **41**: 189-193.

Record of the type species *Zebrospora bicolor* in NC.

McKENZIE E.H.C., 1992. Dematiaceous Hyphomycetes on *Freycinetia* (*Pandanaceae*) 3. *Chalarodes* gen. nov. Mycotaxon **42**: 89-93.

Protologue of the type species *Chalarodes obconica.*

McKENZIE E.H.C., 1993. New species of *Cryptophiale* from New Zealand and New Caledònia. Mycotaxon **46**: 307-312.

Records of *Cryptophiale orthospora* (proposed as new species) and of *C. manifesta* in NC.

McKENZIE E.H.C., 1995. Dematiaceous Hyphomycetes on *Pandanaceae*. 5. *Sporidesmium sensu lato.* Mycotaxon **56**: 9-29.

Records of *Ellisembia vaginata* (new taxon) and of *Sporidesmium freycinetiae* in NC.

McKENZIE E.H.C. & HYDE K.D., 1997. Microfungi on *Pandanaceae*. In 'Biodiversity of Tropical Microfungi' (Hyde D.K., ed.). Hong Kong University Press, pp. 157-177.

Provides all records on hosts of this plant family in NC.

McKENZIE E.H.C. & KUTHUBUTHEEN A.J., 1993. Dematiaceous hyphomycetes on *Freycinetia* (*Pandanaceae*) 4. *Cryptophiale.* Mycotaxon **47**: 87-92.

Protologue of *Cryptophiale novae-caledoniae.*

MOUCHACCA J., 1990. Champignons de Nouvelle-Calédonie I. Quelques dématiées intéressantes de litière forestière. Persoonia **14**: 151-160.

Includes descriptions of six rare dematiaceous taxa being also new records for NC.

MOUCHACCA J., 1990. Champignons de Nouvelle-Calédonie II. Quelques dématiées intéressantes de litière forestière. Nova Hedwigia **51**: 459-468.

Descriptions of six other uncommon dematiaceous taxa previously unrecorded for NC.

MOUCHACCA J., 1997. Francis BUGNICOURT (1907-1991). Crypt. Mycol. **18**: 173-181.

An account of the life history of the French phytopathologist in Vietnam and New Caledonia and of his scientific achievements: lists of publications and of new taxa proposed.

MOUCHACCA J., 1998. Ascomycetes described from New Caledonia, South Pacific Region. Mycotaxon **67**: 99-121.

Includes basic taxonomic information (descriptive and taxonomic) of over 100 species having protologues based on material collected in NC (with fewer from French Polynesia). A comprehensive document on the topic.

MOUCHACCA J. & HORAK E., 1998. Annotated check-list of New Caledonian Basidiomycota. II. Rusts and Smuts. Mycotaxon **69**: 13-20.

Provides basic information of 70 members of both groups having specimens in the Neocaledonian Herbarium in Paris.

MOUCHACCA J. & McKENZIE E.H.C., 1994. Deuteromycetes of New Caledonia. Vth International Mycological Congress, ABSTRACTS, August 14-21, 1994, Vancouver, University of British Columbia, poster abstract, p. 149.

Preliminary information on the project 'Annotated check-list of NC deuteromycetes'.

MOUCHACCA J. & ZUCCONI L., 1994. Fungi of New Caledonia III. Some interesting dematiaceous hyphomycetes from leaf litter. Crypt. Mycol. **15**: 27-38.

Descriptions and distribution of six little documented dematiaceous fungi also being new additions; *Diplocladiella scalaroides* is redescribed from original material.

MÜLLER J., 1884. Lichenes Otaitensis a cl. G. Brunaud lecti et ab. E. Roumeguère communicati. Rev. Myc. (Toulouse) **6**: 90-95.

Provides a list of ten new records for NC. The only new taxon then proposed is *Cora nitida* from Tahiti.

MÜLLER J., 1887. Enumération de quelques lichens de Nouméa. Receuillis par M. Théophile Savés, communiqués par le Chevalier Roumeguère. Rev. Myc. (Toulouse) **9**: 77-82.

Provides a list of 73 lichens including ten new taxa. The names of ten basidiomycetes are also indicated.

NANDRIS D., PELLEGRIN F. & KÖHLER F., 1997. Influence of environment on host-pathogen relationships: coffee pathosystem modeling. P. A. T. P. (Pacific Association of Tropical Phytopathology) Newsletter **15**: 5-7.

NICHOLAS C., 1921. L'essence du niaouli menacée dans sa production en Nouvelle-Calédonie. Bull. Soc. Pathol. Exot. **14**: 396-397.

A saprophytic fungus reported which follows insect damage in *Melaleuca leucodendron.*

NYLANDER W., 1859. *Prodromus expositionis Lichenum Novae Caledoniae.* Ann. Sci. Nat. (Paris), sér. **IV**, Botanique, **12**: 280-284.

A list of lichens collected by Vieillard and Pancher, with several being new taxa.

NYLANDER W., 1861. *Expositio Lichenum Novae Caledoniae*. Ann. Sci. Nat. (Paris), sér. **IV**, Botanique, **15**: 37-54.

Additions to the lichen flora of NC; these bring to 105 the number of recorded taxa.

NYLANDER W., 1867. *Novae explorationes Lichenum Neo-Caledoniae*. Flora **50**: 193-197. Further additions to the lichen flora of NC.

NYLANDER W., 1868. *Synopsis Lichenum Novae Caledoniae*. Bull. Soc. Linn., Normandie, sér. **II**, **2**: 39-140. Seors express. Caen (Blanc. Hardel) 1868.

An updated document on the lichen flora of NC.

O'CONNOR B.A., 1969. Exotic plant pests and diseases. South Pacific Commission, Nouméa, New Caledonia, [Illustrated (some coloured), 244 refs].

A fully illustrated, loose leaf handbook of diseases to be eradicated from, or prevented from spreading, within the area of the South Pacific Commission. The individual diseases (symptoms, spread, damage and control) are described under each crop.

PATOUILLARD N, 1887. Contributions à l'étude des Champignons extraeuropéens. Bull. Trimestriel Soc. Mycol. France **3**: 119-131.

A list of 20 novel taxa including *Hypomyces caledonicus* from NC.

PATOUILLARD N., 1887. Champignons de la Nouvelle-Calédonie (1). Bull. Trimestriel Soc. Mycol. France **3**: 168-178.

A list of 65 taxa identified from material collected by Vieillard, Pancher and Balansa, maintained at the Paris Museum. New taxa reported are: *Bagnisiella palmarum*, *Gibbera pezizoidea*, *Nummularia macrospora* and *Poronia ustorum*; *Hymenochaete perpusilla*, *Lenzites marginata*, *Polyporus mycenoides*, *P. pancheri* and *Polystictus flabelliformis* var. *crenatolobatus*; *Aecidium balansiae* and *Sorosporium caledonicum*.

PATOUILLARD N., 1898. Champignons nouveaux ou peu connus. Bull. Trimestriel Soc. Mycol. France **14**: 149-156.

A list of ten new taxa including *Polyporus spermatolepidis* from NC.

PATOUILLARD N., 1901. Quelques Champignons des colonies françaises. Agric. Prat. Pays Chauds **1** (2): 262-265.

A list of over 30 taxa from NC. New species proposed: *Hexagonia casuarinae*, *Lentinus eradicatus*, *L. radicosus* and *Xanthochrous niaouli*.

PATOUILLARD N., 1902. Descriptions de quelques champignons extraeuropéens. Bull. Trimestriel Soc. Mycol. France **18**: 299-330.

Protologues of 12 taxa with *Hexagonia amplexens* and *Xylaria hemiglossa* collected from NC.

PATOUILLARD N., 1902. Quelques Champignons des Colonies Françaises. Agric. Prat. Pays Chauds **1** (6): 766-767.

The paper contains a list of 12 taxa from the former French Congo and a second list of 20 taxa from NC, including the new *Hexagonia tenuis* forma *nana*.

PATOUILLARD N., 1905. Champignons de la Nouvelle-Calédonie receuillis par M. Le Rat. Agric. Prat. Pays Chauds **5** (2): 522-526.

A list of 30 taxa including the new *Hypoxylon haematostroma* var. *lerati*, *Androsaceus umbrinus*, *Daedalea hydnopora*, *Ungulina lerati* and *U. polychroa*.

PATOUILLARD N., 1906. Un *Mitremyces* de la Nouvelle-Calédonie. In Lloyd, Mycol. Not. **22**: 273-274.

Protologue of *Mitremyces leratii*.

PATOUILLARD N., 1907. *Le Ratia*, nouveau genre de la série des Cauloglossum. Bull. Trimestriel Soc. Mycol. France **23**: 50-52.

Leratia similis gen. nov. & sp. nov. Dedicated to the collector A.J. Le Rat.

PATOUILLARD N., 1908. Champignons nouveaux ou peu connus (3). Bull. Trimestriel Soc. Mycol. France **24**: 1-12.

Treats 21 species from various geographic origins. New taxa from NC are: *Hydnum crocidens* var. *subexcentricum*, *Merulius chlorinus* and *Mycena chlorocephala*.

PATOUILLARD N., 1908. Champignons de la Nouvelle-Calédonie (suite). (2). Bull. Trimestriel Soc. Mycol. France **24**: 165-168.

Three new taxa are proposed: *Crinipellis elatus*, *Spongipellis stramineus* and *Stereum campaniforme*.

PATOUILLARD N., 1909. Champignons de la Nouvelle-Calédonie (suite). (3). IV. Le genre *Trichoglossum* Boud. V. *Le Ratia smaragdina*. Bull. Trimestriel Soc. Mycol. France **25**: 129-134.

Protologues of *Trichoglossum gracile* and *Leratia smaragdina*.

PATOUILLARD N., 1910. Champignons de la Nouvelle-Calédonie (suite). (4). VI. Le genre *Gallacea* Lloyd. Bull. Trimestriel Soc. Mycol. France **27**: 34-38.

Gallacea avellanea sp. nov. The relevant publication year was erroneously given as 1911 by Horak & Mouchacca (1998).

PATOUILLARD N., 1911. Champignons de la Nouvelle-Calédonie (suite). (5). VII. Le genre *Sarcoxylon* Cooke. Bull. Trimestriel Soc. Mycol. France **27**: 329-333. *Sarcoxylon aurantiacum* sp. nov.

PATOUILLARD N., 1915. Champignons de la Nouvelle-Calédonie (suite). (6). Bull. Trimestriel Soc. Mycol. France **31**: 31-35. VIII. *Cyphella crateriformis* sp. nov. IX. *Pleurotus stella* sp. nov. X. *Hysterangium neocaledonicum* sp. nov. XI. *Sarcosoma leratii* sp. nov. XII. *Nummularia fuscodisca* sp. nov.

PATOUILLARD N. & HARIOT P., 1912. *Fungorum novorum Decas quarte*. Bull. Trimestriel Soc. Mycol. France **28**: 280-284.

Descriptions of 10 new taxa including *Clavariopsis pulchella* var. *lutescens* from NC.

PELLEGRIN F., BOCCAS B., KÖHLER F., LAURENT D. & LAMBERT C., 1985. La fusariose du maïs et les mycotoxines fusariennes en Nouvelle-Calédonie. Synthèse des travaux effectués en 1982, 1983, 1984, 1985, 1986. Service de Phytopathologie, Centre ORSTOM Nouméa (technical report), 67 p.

PELLEGRIN F., KÖHLER F., van BERCIE C. & BOCCAS B., 1982. La rouille orangée du caféier Arabica en Nouvelle-Calédonie. Service de Phytopathologie, Centre ORSTOM Nouméa (technical report), 20 p.

PELLEGRIN F., KÖHLER F. & BOCCAS B., 1982. La rouille orangée du caféier Arabica en Nouvelle-Calédonie. Rapport des travaux réalisés en 1981. Rapport des Service de Phytopathologie, Services Ruraux Territoriaux et I. R. C. C., Centre ORSTOM Nouméa (technical report), 19 p.

PELLEGRIN F., KÖHLER F. & BOCCAS B., 1982. La rouille orangée du caféier Arabica en Nouvelle-Calédonie. Rapport des travaux réalisés en 1982. Essais de contrôle chimique. Rapport des Service de Phytopathologie, Services Ruraux Territoriaux et I. R. C. C., Centre ORSTOM Nouméa (technical report), 39 p.

PELLEGRIN F., KÖHLER F., LAMBERT D., KONGOULEUX J., BOCCAS B., LAURENT D., DESOUTTER D. & COLLET L., 1987. La fusariose du maïs et les mycotoxines fusariennes en Nouvelle-Calédonie. Convention ORSTOM-CEE, Service de Phytopathologie, Centre ORSTOM Nouméa (technical report), 97 p.

PELLEGRIN F., KÖHLER F., LAMBERT D., KONGOULEUX J., HAMEURT J., BOCCAS B., LAMBERT D., DOMENECH J. & DESOUTTER D., 1986. La fusariose du maïs en Nouvelle-Calédonie. Rapport sur la Convention ORSTOM-CEE, Service de Phytopathologie, Centre ORSTOM Nouméa (technical report), 49 p.

PELLEGRIN F., KÖHLER F., LAURENT D. & BOCCAS B., 1988. *Fusarium moniliforme* du maïs en Nouvelle-Calédonie : Relations hôte-parasite. Microbiol. Alim. Nut. **6**: 153-158.
Reports on the conditions favouring the development of this *Fusarium* in corn fields.

PELLEGRIN F., LAURENT D., KÖHLER F., COSTA R., THEVENON J. & LAMBERT C., 1992. Etude de la fusarose du maïs et la leucoencéphalomalacie équine en Nouvelle-Calédonie. Synthèse des résultats. Revue d'Elevage et de Médecine Vétérinaire de Nouvelle-Calédonie **14**: 45-50.
Further observations on this horse mycotoxicosis on the island.

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Details about the pathology of the most serious pathogens of Robusta coffee trees: *Heimileia vastatrix* and *Stilbum nanum.*

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A trial to define the relation between rust attack and cultural methods.

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An exhaustive critical survey of the genus *Crinipellis* regarded by plant pathologists as the most important agaric infectious genus. Protologues of several new taxa include *Crinipellis carecomoeis* var. *subelata* and *C. mirabilis* from NC.

SMITH A.L., 1922. Lichens. In A.B. Rendle, E.G. Baker & S. le M. Moore. A systematic account of the plants collected in New Caledonia by Prof. .H. Compton, M.A., in 1914. Part. III. Cryptogams. J. Linn. Soc., Bot. **46**: 71-87.

A list of lichen taxa including some new species.

SMITH G., 1965. Three new species of *Penicillium*, *P. asperisporium* nom. nov. and *P. lapidosum* Raper & Fennell emend. Trans. Brit. Mycol. Soc. **48**: 273-277.

The description of the new *Penicillium novae-caledoniae* is based on a soil-borne strain provided by B. Huguenin; later reduced to synonymy under *P. canescens*.

SPOONER B.N., 1985. A new *Didymophaeria* (Pleosporales) from ascocarps of *Corynelia uberata*. Trans. Brit. Mycol. Soc. **85**: 545-547.

Protologue of *Didymosphaeria corynelia.*

UDAGAWA S.-I., UCHIYAMA S. & KAMIYA S., 1994. Two new pyrenomycetous Ascomycetes from New Caledonia. Mycoscience **35**: 319-325.

Protologues of *Anthostomella pacifica* and *Chaetomium nova-caledonicum*.

UDAGAWA S.-I., UCHIYAMA S. & KAMIYA S., 1994. A second species of *Ascotricha* with non-ostiolate ascomata. Mycotaxon **52**: 215-220.

Description of the new *Ascotricha novae-caledoniae.*

VIEILLARD E., 1862. Plantes utiles de la Nouvelle-Calédonie. Ann. Sci. Nat., Paris, sér. **IV**, Botanique, **16**: 228-276.

Indicates the names of two edible fungi (a *Hydnum* close to *H. caput-medusae* Fr. and *Agaricus edulis* Bull. ?) consumed at that time by the natives and European peoples.

VOUAUX Léon (l'abbé), 1910. Description de quelques espèces de Champignons. Bull. Trimestriel Soc. Mycol. France **26**: 153-157.

Protologues of 8 ascomycetes; *Diatrypella fourcroyae*, *Nummularia oospora*, *Phragmonaevia lignicola*, *Gloniella insularis* and *Gloniopsis xylogramma* are from NC.

WAKEFIELD E. M., 1920. Fungi of New Caledonia and the Loyalty Islands. In 'F. Sarasin & J. Roux. Recherche Scientifique Nouvelle Calédonie et aux Iles Loyalty'. B: Botanique, Berlin, vol. **1** (2): 89-108.

A list of almost 100 taxa of ascomycetes and basidiomycetes with an additionnal set of ten lichens. The former comprises the ten new species earlier reported by Wakefield *et al.* (1916).

WAKEFIELD E. M., 1922. Fungi (on New Caledonia). In 'Pendle A.B., Baker E.G. & Muare S.G.M. A systematic account of the plants collected in New Caledonia and Isle of Pines by Professor R.H. Compton'. Manuscript Admitted in 1914; Part 3: Cryptogams (Hepaticae-Fungi). J. Linn. Soc., Bot. **46**: 8-93.
Provides a list of 33 taxa with nine being new records for NC while two others represent new taxa: *Encoelia neocaledonica* and *Clavaria flabellata*.

WAKEFIELD E.M., MASSEE G. & COTTON A.D., 1916. Neucaledonische Pilze. Vierteljahrsschrift der Naturfrschenden Gesellschaft in Zürich **61**: 628-631 (manuscript submitted in April 1914).
A list of ten new species based on material collected by F. Sarasin and J. Roux in NC and the Loyalty Islands: *Nectria nigro-ostiolata*, *Xylaria hirtella*, *Amanita pumila*, *Clavaria sarasini*, *Dacryomitra tenuis*, *Lachnocladium neglectum*, *Leratia coccinea*, *Marasmius sulcatus* and *Stereum* (*Lloydiella*) *umbrinoalutaceum*.

ZANG M.U., 1995. A new species of the genus *Gastroboletus* from New Caledonia. Mycotaxon **54**: 408-412.
Protologue of *Gastroboletus doii*.

DISCUSSION

The first report on fungi of New Caledonia is by Léveillé (1845). He described *Depazea celastrina* based on a specimen collected by L.A. Deschamps and J. La Billardière during the first French expedition to the island led by d'Entrecasteaux in 1793. The establishment of a European settlement in 1853 triggered a serious interest in the mycobiota of this tropical territory. This is evidenced by the number of documents that were published on this group of microorganisms. This interest persisted until the advent of the first World War. A major characteristic of the early papers is their authorship by overseas mycologists in European centres.

Significant contributions of the early pioneer years are those of Nylander (1859-1868) and Müller (1884-1887) on lichens of New Caledonia. Basidiomycetes, and to a less extent Ascomycetes (and deuteromycetes), were reported in a notable series of papers appearing over a period of thirty years. These major documents are principally due to Patouillard (1887-1915). By comparison, papers by resident contributors are few and of little substance. They merely report information linked to edible mushrooms (Vieillard, 1862) or relate to the outbreak of *Hemileia vastatrix* (coffee rust) in parts of New Caledonia (Blandeau, 1911; Fraysse, 1911; Peyrot, 1910).

Studies achieved before World War I were based on material present in the Paris Museum and collected earlier by E. Vieillard and E. Déplanche, or later on by I. Pancher and B. Balansa. Besides these specimens, additional material was regularly sent by resident collectors such as J. Bérnier and A.J. Le Rat, directly or indirectly to N. Patouillard.

The period between the two World Wars was very unproductive with regard to fungal studies and only four titles appeared during these years. They were authored by non-mycologists such as Nicholas (1921) and Risbec (1930-1936). Indeed, the advent of steamships drastically reduced the frequency of ships anchoring in Nouméa for renewal of supply and this severly affected the overall island activity. Besides, damage in Europe during the war years, relegated to a low priority any interest in far away French territories.

The advent of World War II highlighted the strategic importance of the island in the South Pacific region. This was evidenced by the rapid establishment of a very important allied base in the southern part of New Caledonia. This presence indirectly revived interest in activities involving fungi. Thus in 1949, the new 'Institut Français d'Océanie (IFO)' was created at Nouméa (now Centre IRD-ORSTOM de Nouméa). Establishment of the Institute led to a surge of local scientific studies conducted by resident plant pathologists.

Notable interest in plant pathogenic fungi of New Caledonia started with the arrival of R. Dadant in 1947 (-1953). He was immediately followed by F. Bugnicourt in 1949 (-1961) and later by J. Marty (1956-1961). This expert team endeavoured to prepare a list of plant diseases of economic importance and to recommend appropriate control measures (see Combes, 1952). The result was a series of publications (including several internal technical reports) extending throughout the period from 1949 to 1961.

In 1962, B. Huguenin replaced the former phytopathologists. He rapidly undertook intensive collecting in the area. Titles of Huguenin's series 'Micromycètes du Pacifique Sud' appeared from 1962 to 1969, along with several internal technical reports. Following Huguenin's relocation in Africa, interest in local plant pathology problems stopped for a period of ten years. It resumed with the arrival of F. Köhler and F. Pellegrin and a few other specialists of ORSTOM. From 1981 onwards, papers appeared relating to coffee rust (*Hemileia vastatrix*) and a mycotoxicosis of horses induced by *Fusarium moniliforme* developing on maize grains. This research period has just ended (1999) with the return to France of the resident phytopathologists.

The study of saprobic fungi was the main interest of mycologists visiting the island or receiving material from local correspondents. Among notable post World War II visitors were R. Heim and E. Horak, both of whom were interested in basidiomycete taxa. Heim collected in New Caledonia on two occasions in addition to receiving specimens. In a series of papers from 1951 to 1968, he provided descriptions and protologues of several interesting higher fungi. Horak visited the island several times starting from 1967. Observations resulting from his collections were reported in a series of papers beginning in 1977. This flow of publications is still ongoing.

In line with this activity, Mouchacca (1998) surveyed records of new ascomycetes described from New Caledonia. He also provided some information on hyphomycetes inhabiting forest litter and initiated a survey of this taxonomic group. Some records of hyphomycetes have been also provided by McKenzie since 1991.

Besides these publications a few casual taxonomic papers have been authored by other mycologists, mostly after 1950. Also the concomitant creation with the IFO Centre of the South Pacific Commission in Nouméa enhanced research in various fields of local interest within the widespread islands of the Pacific. This resulted in the production of large documents reporting titles on plant pathology and mycology in the area including New Caledonia (Firman, 1975-1978).

Mycological knowledge of New Caledonia is very poor when compared with the well studied, rich vegetation of this tropical land. The 'Flore de Nouvelle Calédonie' issued by the Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle, Paris, comprises 22 volumes, appearing since 1961. These documents confirm this tropical island has an extremely diverse and interesting flora with many endemic plants. This high degree of endemism would suggest that interesting plant-fungus associations await to be discovered besides the saprobic tropical fungi.

ACKNOWLEDGEMENTS

This study was undertaken as part of the multidisciplinary project 'Land Biodiversity in New Caledonia' of the Muséum National d'Histoire Naturelle, Paris. Dr E.H.C. McKenzie is gratefully acknowledged for his endeavour to upgrade the English level of the text and for accepting to review (with much enthusiasm), together with Prof. E. Horak, this note for Mycotaxon. Dr. F. Pellegrin kindly provided some missing references.

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MYCOTAXON

Volume LXXIV(1), pp. 105-118 January-March 2000

NOTES ON KOREAN CERCOSPORAE AND ALLIED GENERA (III)

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The present paper continues the investigations on Korean Cercosporae. Shin and Braun (1993, 1996) listed 77 species of this group of fungi including six new species, one new variety, four new combinations, one new name, and 50 new records for Korea. Thirty species are listed in the present paper, including three new species and two new combinations. The new species *Cercosporella cimicifugae*, *Pseudocercospora cercidis-chinensis*, and *P. lythri* are described and illustrated. Furthermore, *Cercospora pallida* and *C. liriopes* are transferred to *Pseudocercospora* and *Stenellopsis*, respectively. Most species are new to the fungus flora of Korea.

All samples were collected by H.D. Shin in Korea between 1991-1998, and the examinations of the material were carried out in collaboration between the two authors. Most of the common species are not fully described, as they have been dealt with in other important reference books on Cercosporae. All specimens, including type collections, are deposited in the herbarium (SMK) of the Department of Agricultural Biology, Korea University, Seoul, Korea. Duplicates are housed at HAL.

(1) *Cercospora citrullina* Cooke, Grevillea 12: 31 (1883)

On *Cucurbita moschata* Duchesne, Seoul, Korea, 3 X 1997, Shin; on *Luffa cylindrica* (L.) Roem., Suwon, Korea, 23 X 1997, Shin. This fungus is known on *C. moschata* (Park, 1967), but *L. cylindrica* is a new host species for Korea.

(2) *Cercospora coreopsidis* Ray, Mycologia 33: 174 (1941)
On *Coreopsis lanceolata* L., Chunchon, Korea, 19 VIII 1998, Shin. This is the first record of this species from Korea.

(3) *Cercospora flagellaris* Ellis & G. Martin, Amer. Nat. 16: 1003 (1882)
On *Phytolacca esculenta* Van Houtte, Chunchon, Korea, 6 X 1996, Shin. Known from Korea (Kim and Shin, 1999b).

(4) *Cercospora gomphrenae* Ray, Mycologia 36: 172 (1944)
On *Gomphrena globosa* L., Yangku, Korea, 4 X 1998, Shin. This is the first record of this species from Korea.

(5) *Cercospora hydrangeae* Ellis & Everh., J. Mycol. 8: 71 (1902)
On *Hydrangea macrophylla* (Thunb.) Serige (= *H. paniculata* Sieb.), Suwon, Korea, 2 X 1998, Shin; on *H. serrata* var. *acuminata* (Sieb. & Zucc.) Wils., Chunchon, Korea, 9 X 1998, Shin. This is the first record of this species from Korea.

(6) *Cercospora kikuchii* T. Matsumoto & Tomoy., Ann. Phytopath. Soc. Japan 1(6): 1 (1925)
On *Glycine max* (L.) Merr., Chunchon, Korea, 1 X 1998, Shin. Known from Korea (Nakata and Takimoto, 1928; Kim and Shin, 1999a).

(7) *Cercospora mirabilis* Tharp, Mycologia 9: 111 (1917)
On *Mirabilis jalapa* L., Suwon, Korea, 17 X 1997, Shin. This is the first record of this species from Korea.

(8) *Cercospora physalidis* Ellis, Amer. Nat. 16: 810 (1882)
On *Physalis alkekengi* var. *franchetii* (Masters) Hort., Chunchon, Korea, 19 VIII 1998, Shin. This is the first record of this species from Korea.

(9) *Cercospora plantaginis* Sacc., Michelia 1: 267 (1879)
On *Plantago lanceolata* L., Suwon, Korea, 30 X 1996, Shin. This is the first record of this species from Korea.

(10) *Cercospora ricinella* Sacc. & Berl., Atti R. Ist. Ven. Sci. Lett. Arti. VI. 3: 721 (1885)
On *Ricinus communis* L., Chunchon, Korea, 9 X 1998, Shin. Known from Korea (Nakata and Takimoto, 1928).

(11) *Cercospora tabacina* Ellis & Everh., J. Mycol. 4: 6 (1888)
On *Rudbeckia bicolor* Nutt., Suwon, Korea, 17 X 1997, Shin. This is the first record of this species from Korea.

(12) *Cercospora volkameriae* Speg., Rev. Mus. de la Plata 15: 47 (1908)

On *Cleodendron trichotomum* Thunb., Seoul, Korea, 16 IX 1997, Shin. This is the first record of this species from Korea.

(13) ***Cercosporella cimicifugae*** sp. nov. Fig. 1.

Maculae amphigenae, disseminatae vel confluentes, angulares vel irregulares, per venas limitatae, plerumque 3-10 mm latae, vel confluentes et usque 20 mm latae, in epiphyllo in centro griseo-brunneae, in hypophyllo griseo-brunneae vel atrobrunneae. Caespituli hypophylli. Mycelium immersum; hyphae septatae, ramosae, fere incolorae. Stromata nulla vel parva, ex cellulis paucis, inflatis, olivaceis composita. Conidiophora fasciculata (3-10), per stoma emergentia, recta vel subrecta, non geniculata, non ramosa, hyalina vel subhyalina, 0-1(-2)-septata, apicem versus attenuata, 20-50 × 4-6.5 µm. Cicatrices conidiales conspicuae, terminales et laterales, 2-3 µm diam., convexae vel subtruncatae, incrassatae, non vel leniter fuscatae. Conidia solitaria, filiformia vel obclavato-cylindrica, recta vel leniter curvata, hyalina vel subhyalina, guttulata, 1-14-septata, ad septa constricta, 40-180 × 5.5-9.5 µm, apice obtusa vel subobtusa, basi obconico-truncata vel obtusa; hila incrassata, non vel leniter fuscata, 2-3 µm lata.

Leaf spots amphigenous, scattered to confluent, angular to irregular, vein-limited, 3-10 mm diam., or up to 20 mm or more when confluent, centre greyish brown with dark brown margins on the upper surface, greyish brown to deep brown without definite margins on the lower surface. Caespituli hypophyllous. Mycelium internal, hyphae septate, branched, almost colourless. Stromata lacking to small, rudimentary to poorly developed, composed of a few swollen, brown hyphal cells. Conidiophores 3-10 in loose fascicles from stomatal openings, straight to substraight, not geniculate, not branched, hyaline to subhyaline throughout, 0-1(-2)-septate, irregular in width, gently tapered at the upper portion, 20-50 × 4-6.5 µm; conidial scars conspicuous, terminal and lateral, 2-3 µm diam., somewhat protuberant, convex to subtruncate, thickened, not or only slightly darkened, but refractive. Conidia solitary, filiform to obclavate-cylindric, straight to mildly curved, hyaline to subhyaline due to oil drops, guttulate, 1-14-septate, constricted at the septa, variable in length, 40-180 × 5.5-9.5 µm, obtuse to subobtuse at the apex, short obconically truncate to obtuse at the base; hilum thickened, not or only slightly darkened, refractive, slightly protuberant, 2-3 µm wide.

Holotypus: On leaves of *Cimicifuga heracleifolia* Kom. (Ranunculaceae), Kangnung, Korea, 24 IX 1998, Shin (SMK 15224).

Isotypus: HAL.

Note: Two species of cercosporoid fungi have been recorded on *Cimicifuga* spp. *Phaeoramularia actaeae* (Ellis & Holw.) U. Braun (1993) is clearly

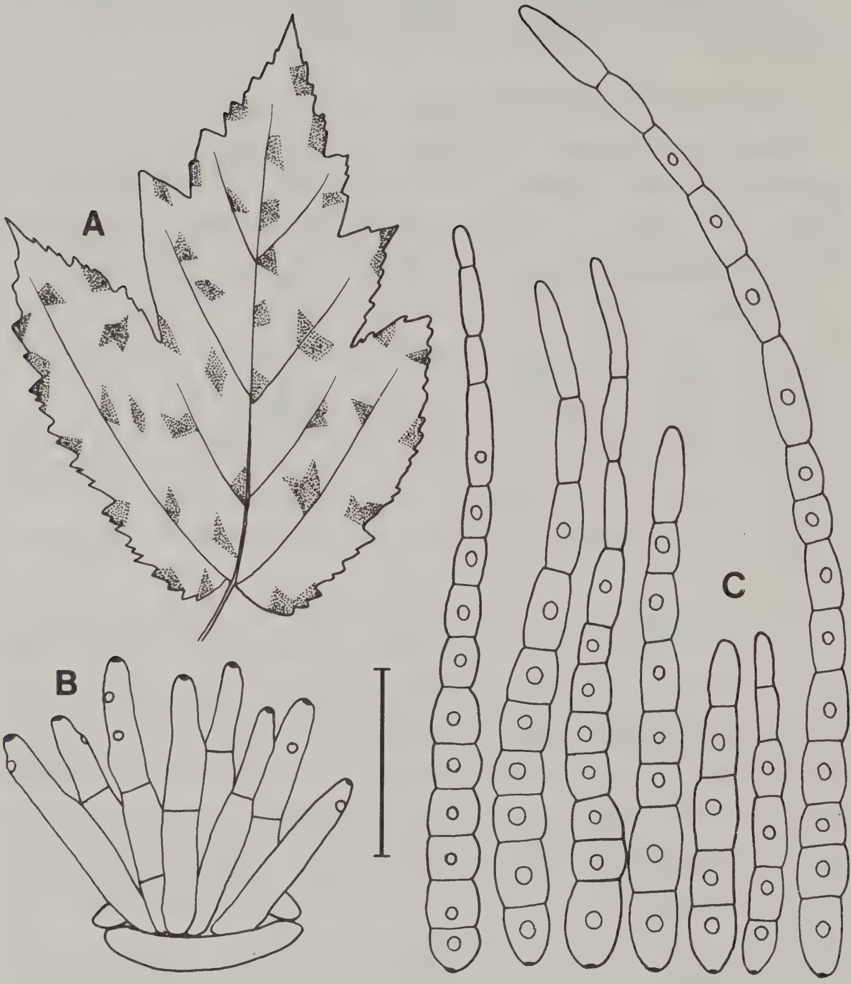

Fig. 1. *Cercosporella cimicifugae* sp. nov.: **A.** Leaf spots on *Cimicifuga heracleifolia*; **B.** Conidiophores; **C.** Conidia. Bar = 30 µm. H.D. Shin del.

different from the present fungus by having pigmented conidiophores and catenate conidia. *Cercospora cimicifugae* Pai & P.K. Chi (1965) is a true member of the genus *Cercospora* s. str., morphologically hardly distinct from *C. apii* s. lat. The present fungus is well-characterized by clourless conidiophores and its guttulate, constricted, large conidia. There is no comparable

Cercosporella species. Therefore, this fungus must be considered as a new, undescribed species.

(14) *Mycovellosiella ariae* (Fuckel) U. Braun, Hedwigia 50: 518 (1990)

On *Sorbus commixta* Hedl., Seoul, Korea, 17 VIII 1998, Shin. This is the first record of this species from Korea.

(15) *Pseudocercospora abelmoschi* (Ellis & Everh.) Deighton, Mycol. Pap. 140: 138 (1976)

On *Hibiscus syriacus* L., Hongchon, Korea, 21 VIII 1998, Shin. This is the first record of this species from Korea.

(16) ***Pseudocercospora cercidis-chinensis*** sp. nov. Fig. 2.

Syn.: *Cercospora cercidis* Nishikado, Nogaku-Kenkyu 36: 411-415 (1944), nom. illeg.; non *C. cercidis* Ray, 1941.

Misapplied names: *Cercospora chionea* sensu Katsuki (1965: 39), Chupp (1954: 293) p. p.; *Pseudocercospora chionea* (Ellis & Everh.) X.J. Liu & Y.L. Guo, Mycosystema 2: 231 (1989)

Maculae amphigenae, disseminatae vel confluentes, subcirculares vel irregulares, 2-10 mm diam., in epiphyllo griseo-brunneae vel atrobrunneae, in hypophyllo griseo-brunneae vel rubro-brunneae. Casepituli amphigeni. Mycelium primarium immersum; hyphae septatae, ramosae, fere hyalinae. Mycelium secundarium externum; hyphae sepatae, ramosae, olivaceo-brunneae. Stromata magna, bene evoluta, globosa, erumpentes, olivaceo-brunnea vel brunnea, 20-50 µm diam. Conidiophora usque 20 in fasciculo denso, leniter divergentia, substomatalia, recta vel subrecta, non geniculata, non ramosa, pallide olivaceo-brunnea, 0-1-septata, 10-40 × 3-5.5 µm. Cicatrices conidiales inconspicuae. Conidia solitaria, filiformia vel obclavato-cylindrica, recta vel leniter curvata, pallidissime olivacea vel subhyalina, guttulata, 3-7-septata, ad septa non constricta, 40-85 × 2.5-4 µm, apice obtusa vel subobtusa, basi obconica vel truncata; hila inconspicua.

Leaf spots amphigenous, scattered to confluent, subcircular to irregular, 2-10 mm diam., greyish brown to dark brown with blackish brown margins on the upper surface, greyish brown to dull reddish brown without definite margins on the lower surface. Caespituli amphigenous. Primary mycelium internal, hyphae septate, branched, almost colourless. Secondary mycelium external, hyphae septate, branched, olivaceous brown. Stromata large, well-developed, globular, erumpent, olivaceous brown to brown, 20-50 µm diam. Conidiophores up to 20 in very dense fascicles, emerging through stomatal openings, slightly divergent, straight to substraight, not geniculate, not branched, pale olivaceous brown, 0-1-septate, irregular in width, 10-40 × 3-

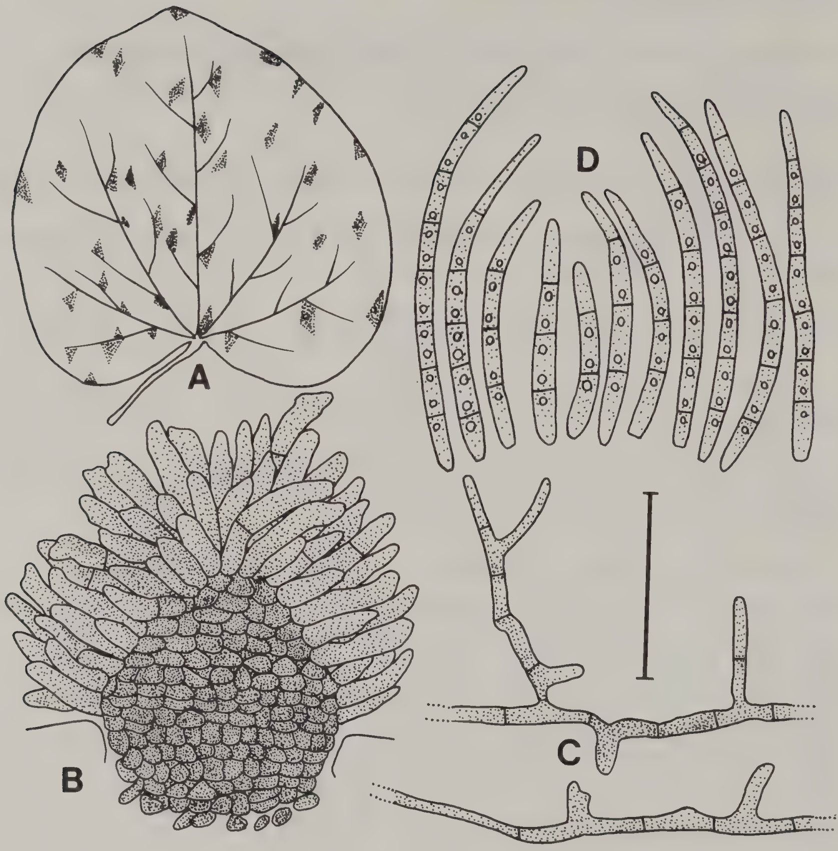

Fig. 2. *Pseudocercospora cercidis-chinensis* sp. nov.: **A.** Leaf spots on *Cercis chinensis*; **B.** Conidiophores; **C.** Conidia. Bar = 30 µm. H.D. Shin del.

5.5 µm; conidial scars inconspicuous. Conidia solitary, filiform to obclavate-cylindric, straight to mildly curved, very pale olivaceous to subhyaline, guttulate, 3-7-septate, not constricted at the septa, 40-85 × 2.5-4 µm, obtuse to subobtuse at the apex, obconic to truncate at the base; hilum unthickened, not darkened.

Holotypus: On leaves of *Cercis chinensis* Bunge (Leguminosae), Kyongju, Korea, 26 VIII 1998, Shin. (SMK 14924).

Isotypus: HAL.

Note: Chupp (1954) placed collections of cercosporoid hyphomycetes on *Cercis chinensis* from Asia in *Cercospora chionea* Ellis & Everh. Katsuki (1965) and Guo and Hsieh (1995) followed Chupp's treatment. Guo and Liu (1989) reallocated *C. chionea* to *Pseudocercospora*. The cercosporoid fungus on *C. chinensis*, which is widespread in China and Japan, is, indeed, a member of *Pseudocercospora*, but not conspecific with *C. chionea*. Braun (1993b) re-examined type material and various other North American collections on *Cercis canadensis*. Based on the conspicuous conidial scars observed on the fungus occurring on these specimens, a new combination in *Passalora* as *P. chionea* was introduced. Since there is no valid name for the *Pseudocercospora* species occurring on *C. chinensis*, it is necessary to introduce a new name.

(17) *Pseudocercospora clematidis* Goh & W.H. Hsieh, Trans. Mycol. Soc. R.O.C. 4: 6 (1989)

On *Clematis apiifolia* A.P. DC., Kangnung, Korea, 24 IX 1998, Shin. This is the first record of this species from Korea.

(18) *Pseudocercospora contraria* (Syd. & P. Syd) Deighton, Mycol. Papers 140: 30 (1976)

On *Dioscorea quinqueloba* Thunb., Kimhae, Korea, 6 X 1998, Shin. This is the first record of this species from Korea.

(19) *Pseudocercospora cotoneasteri* (Katsuki & Kobayashi) Deighton, Trans. Brit. Mycol. Soc. 88: 389 (1987)

On *Cotoneaster integerrima* Medicus, Jinju, Korea, 18 IX 1998, Shin. This is the first record of this species from Korea.

(20) *Pseudocercospora cruenta* (Sacc.) Deighton, Mycol. Pap. 140: 142 (1976)

On *Vigna sinensis* King, Seoul, Korea, 13 IX 1998, Shin. Known from Korea (Park, 1967).

(21) *Pseudocercospora lythracearum* (Heald & F.A. Wolf) X.J. Liu & Y.L. Guo, Acta Mycol. Sin. 11: 294 (1992)

On *Lagerstroemia indica* L., Jinju, Korea, 18 IX 1998, Shin. This is the first record of this species from Korea.

(22) ***Pseudocercospora lythri*** sp. nov. Fig. 3.

Maculae amphigenae, disseminatae vel confluentes, plerumque per venas limitatae, 2-5 mm diam., interdum usque 10 mm latae, brunneae vel rubrobrunneae, margine indistincto. Caespituli amphigeni. Mycelium primarium immersum; hyphae septatae, ramosae. Mycelium secundarium externum, amphigenum; hyphae exigue ramosae, subhyalinae vel pallide olivaceae, leves, septatae, 1.5-4 µm latae. Stromata minuta vel magna, bene evoluta, subglobosa, 15-45 µm diam., brunnea vel atrobrunnea, ex cellulis olivaceis, inflatis composita. Conidiophora fasciculata (3-30), subrecta vel geniculato-sinuosa, non ramosa, olivaceo-brunnea, basim versus pallidiora, 0-3-septata, (10-)20-90 × 2.5-4(-5.5) µm; cicatrices conidiales inconspicuae; cellulae conidiogenae integratae, terminales, 10-30 µm longae; conidiophora secundaria solitaria, lateralia, erecta. Conidia solitaria, obclavato-subcylindrica, subrecta vel leniter curvata, pallide olivaceo-brunnea vel subhyalina, 1-13-septata, ad septa leniter constricta, 20-110 × 3-5 µm, apice obtusa vel subobtusa, basi obconico-truncata vel subtruncata; hila non incrassata, non fuscata, 1-2 µm lata.

Leaf spots amphigenous, scattered to confluent, angular to irregular, usually vein-limited, 2-5 mm diam., sometimes up to 10 mm or more, brown to reddish brown without definite margins. Caespituli amphigenous. Primary mycelium internal, hyphae septate, branched. Secondary mycelium external, amphigenous; hyphae creeping, sparingly branched, subhyaline to pale olivaceous, smooth, septate, 1.5-4 µm wide. Stromata small to large, well-developed, subglobular, 15-45 µm diam., brown to deep brown, composed of olivaceous, swollen hyphal cells. Conidiophores 3-30 in loose to dense fascicles, substraight to geniculate-sinuous, not branched, olivaceous brown at the base and paler upwards, 0-3-septate, (10-)20-90 × 2.5-4(-5.5) µm; conidial scars inconspicuous; conidiogenous cells integrated, terminal, 10-30 µm long; secondary conidiophores solitary, arising from creeping hyphae, lateral, erect. Conidia solitary, obclavate-subcylindric, substraight to mildly curved, pale olivaceous brown to subhyaline, 1-13-septate, slightly constricted at the septa, variable in length, 20-110 × 3-5 µm, obtuse to subobtuse at the apex, obconically truncate to subtruncate at the base; hilum unthickened, not darkened, 1-2 µm wide.

Holotypus: On leaves of *Lythrum anceps* (Köhne) Makino (Lythraceae), Chunchon, Korea, 21 IX 1991, Shin (SMK 11109).

Isotypus: HAL.

Additional specimens preserved: SMK 11882 (19 VIII 1992, Suwon), 12975 (12 IX1994, Suwon), 15283 (1 X 1998, Suwon).

Note: *Stenella lythri* (Westend.) Mulder is the only cercosporoid species recorded on *Lythrum* spp. Several other species recorded on Lythraceae are listed in Chupp's (1954) monograph, but the present fungus is not closely related to them. It is, however, allied to *Pseudocercospora lagerstroemiigena* Goh & W.H. Hsieh (Hsieh and Goh, 1990), but differs in having wider conidia.

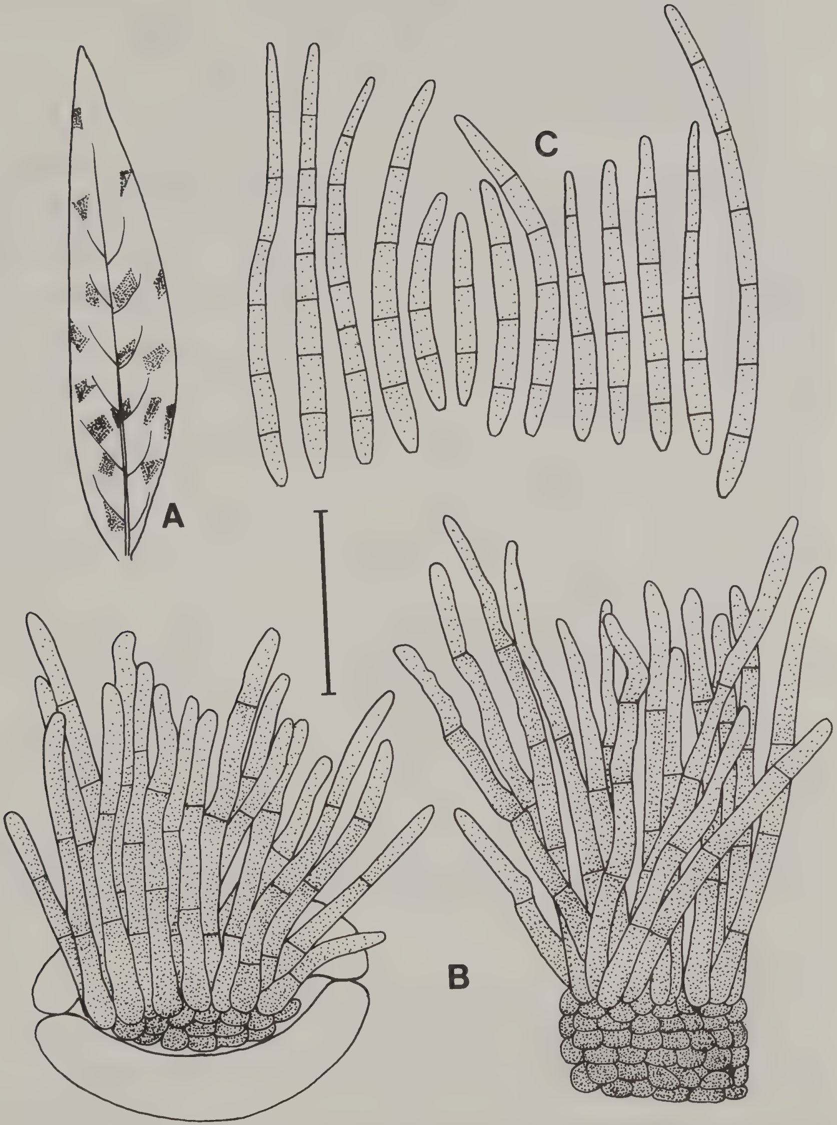

Fig. 3. *Pseudocercospora lythri* sp. nov.: **A.** Leaf spots on *Lythrum anceps*; **B.** Conidiophores; **C.** Conidia. Bar = 30 µm. H.D. Shin del.

(23) ***Pseudocercospora pallida*** (Ellis & Everh.) comb. nov. Fig. 4.

Bas.: *Cercospora pallida* Ellis & Everh., J. Mycol. 3: 21 (1887), non *C. pallida* (Berk. & M.A. Curtis) Cooke, 1888.
= *Cercospora langloisii* Sacc., Syll. Fung. 10: 647 (1892)
= *C. duplicata* Ellis & Everh., J. Mycol. 5: 70 (1889)
= *C. capreolata* Ellis & Everh., J. Mycol. 8: 70 (1902)

Leaf spots amphigenous, scattered to confluent, distinct, circular to angular, 1-6 mm diam., occasionally confluent and larger, at first greyish brown to brown with indistinct margins, later centre appearing greyish white with indistinct border lines. Caespituli epiphyllous. Mycelium internal, hyphae septate, branched, hyaline. Stromata small to medium, globular to subglobular, 16-35 μm diam., brown to dark brown, composed of several brown hyphal cells. Conidiophores usually reduced to conidiogenous cells, 10-35(-50) in very dense fascicles, erumpent through the cuticle, straight to substraight, not geniculate, not branched, olivaceous brown to pale brown, aseptate, 12-26 × 2.5-4 μm; conidial scars inconspicuous. Conidia solitary, filiform-cylindric, narrowly obclavate-subcylindric in shorter ones, straight to mildly curved, subhyaline to very pale olivaceous, guttulate, 2-11-septate, not constricted at the septa, variable in length, 20-105 × 2-4 μm, subacute to subobtuse at the apex, obconically truncate at the base; hilum unthickened, not darkened, 1 μm wide.

On leaves of *Campsis grandiflora* K. Schum. (Bignoniaceae), SMK 15005 (4 IX 1998, Seoul), 15122 (18 IX 1998, Jinju), 15295 (1 X 1998, Suwon), 15411 (8 X 1998, Suwon), and 15633 (3 XI 1998, Seoul).

Note: The present material agrees perfectly with Chupp's (1954) description of this species. He mentioned that the conidial scars are inconspicuous, which could be confirmed in the course of the present study. Hence, *C. pallida* has to be allocated to *Pseudocercospora*. Chupp (l.c.) used the name *C. duplicata* for this species, but *C. pallida* Ellis & Everh. is the correct name. The combination *C. pallida* (Berk. & M.A. Curtis) Cooke was introduced in 1888, so that this name has to be considered as an illegitimate homonym.

(24) *Pseudocercospora rubi* (Sacc.) Deighton, Mycol. Papers 140:152 (1976)
On *Rubus coreanus* Miq., Jinju, Korea, 19 IX 1998, Shin.

Note: Shin and Braun (1996) treated a Korean collection on *Rubus oldhamii* as var. *subhyalina* because of its subhyaline conidiophores and conidia. The present material is rather close to var. *rubi*: Fructifications usually epiphyllous; conidiophores longer (13-50 μm) and pale olivaceous brown; conidia obconically truncate at the base and obtuse to subacute at the apex. Therefore, this collection is somewhat intermediate between the two varieties. *R. coreanus* was recorded as a host plant for this species from Korea (Kim and Shin, 1999a).

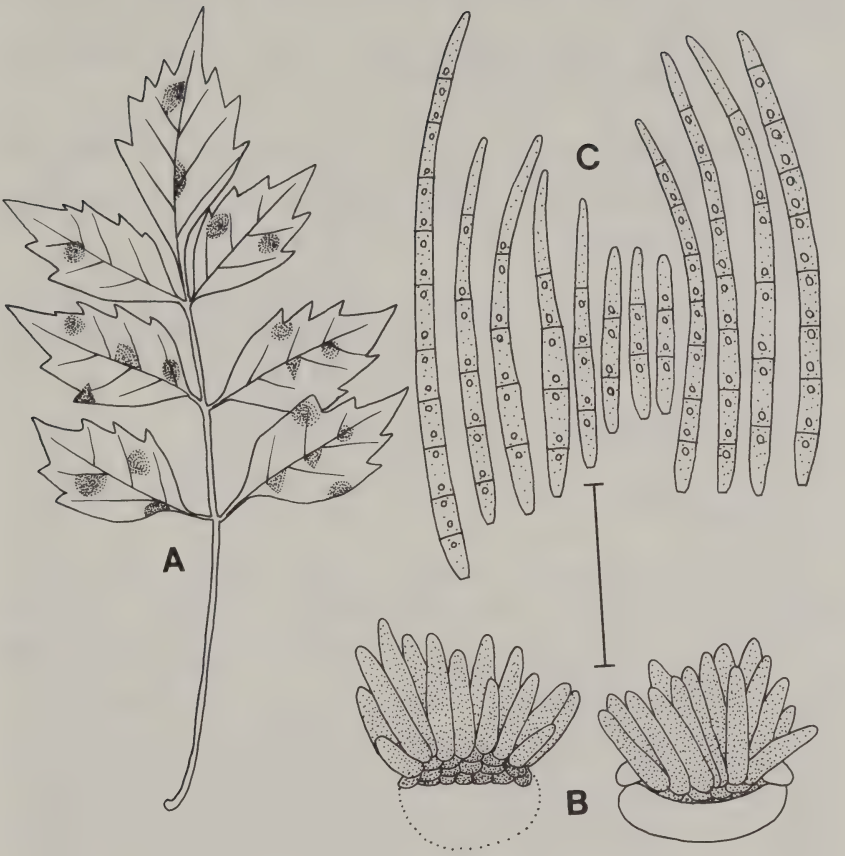

Fig. 4. *Pseudocercospora pallida* comb. nov.: **A.** Leaf spots on *Campsis grandiflora*; **B.** Conidiophores; **C.** Conidia. Bar = 30 μm. H.D. Shin del.

(25) *Pseudocercospora salicina* (Ellis & Everh.) Deighton, Mycol. Papers 140: 96 (1976)

On *Salix* sp., Kangnung, Korea, 9 X 1996, Shin. Known from Korea (Kim and Shin, 1999b).

(26) *Pseudocercospora varia* (Peck) J.K. Bai & M.Y. Cheng, Acta Mycol. Sin. 11: 123 (1992)

On *Viburnum sargentii* Köhne, Pyongchang, Korea, 25 VIII 1998, Shin. This is the first record of this species from Korea.

(27) *Pseudocercospora zelkowae* (Hori) X.J. Liu & Y.L. Guo, Acta Mycol. Sin. 12: 33 (1993)

On *Zelkowa serrata* Makino, Seoul, Korea, 4 IX 1998, Shin. (Anonymous, 1940; Kim and Shin, 1999a).

(28) *Ramularia grevilleana* (Tul. & C. Tul) Jørst. var. *grevilleana*, Meld. Stat. Plantenpatol. Inst. 1: 17 (1945) emend. U. Braun

On *Fragaria ananassa* (L.) Duchesne, Yangku, Korea, 7 VI 1998, Shin. Known from Korea (Park, 1967).

(29) *Ramularia wisconsina* H.C. Greene, Amer. Midland Nat. 44: 641 (1950)

On *Erechtites hieracifolia* (L.) Raf., Seoul, Korea, 30 VII 1998, Shin. This is the first record of this species from Korea.

(30) ***Stenellopsis liriopes*** (F.L. Tai) comb. nov. Fig. 5.

Bas.: *Cercospora liriopes* F.L. Tai, Sci. Repts. Natl. Tsing Hua Univ. B. 2: 431, 1937.

Leaf spots amphigenous, scattered, circular, 1-5 mm diam., centre appearing tan to dingy grey with reddish brown raised margins, sometimes with blackish dots in the centre of the upper surface when viewed by means of a hand lens. Caespituli amphigenous, punctiform, blackish. Mycelium internal, hyphae septate, branched, hyaline, 2-4 µm wide. Stromata large, well-developed, globular, 25-70 µm diam., dark brown to blackish brown, composed of several swollen hyphal cells. Conidiophores (5-)10-40 in loose to dense fascicles, arising from stomata and erumpent through the cuticle, substraight to curved, sometime sinuous, not geniculate, not branched, olivaceous brown throughout, 0-2-septate, smooth or almost so, variable in length, 5-40 × 2-4 µm; conidiogenous cells integrated, terminal or conidiophores reduced to conidiogenous cells; conidial scars visible, truncate, 1-2 µm diam., unthickened to slightly thickened, somewhat darkened, refractive. Conidia solitary, subcylindric-obclavate, mildly curved to straight, subhyaline, verruculose, not constricted at the septa, (0-)2-6-septate, (10-)20-100 × 2.5-3.5 µm, obtuse at the apex, obconically truncate to subtruncate at the base; hilum unthickened, not darkened, 1-2 µm wide.

On leaves of *Liriope platyphylla* Wang & Tang (Liliaceae s. lat. [Convallariaceae]). SMK 14852 (21 VIII 1998, Chunchon), 15279 (1 X 1998, Seoul).

Note: The morphological features of this collection agree well with those given in the description of *Cercospora liriopes* F.L. Tai, but the latter species is not congeneric with *Cercospora* s. str. The conidia are conspicuously verruculose and the conidial scars are truncate, unthickened to slightly

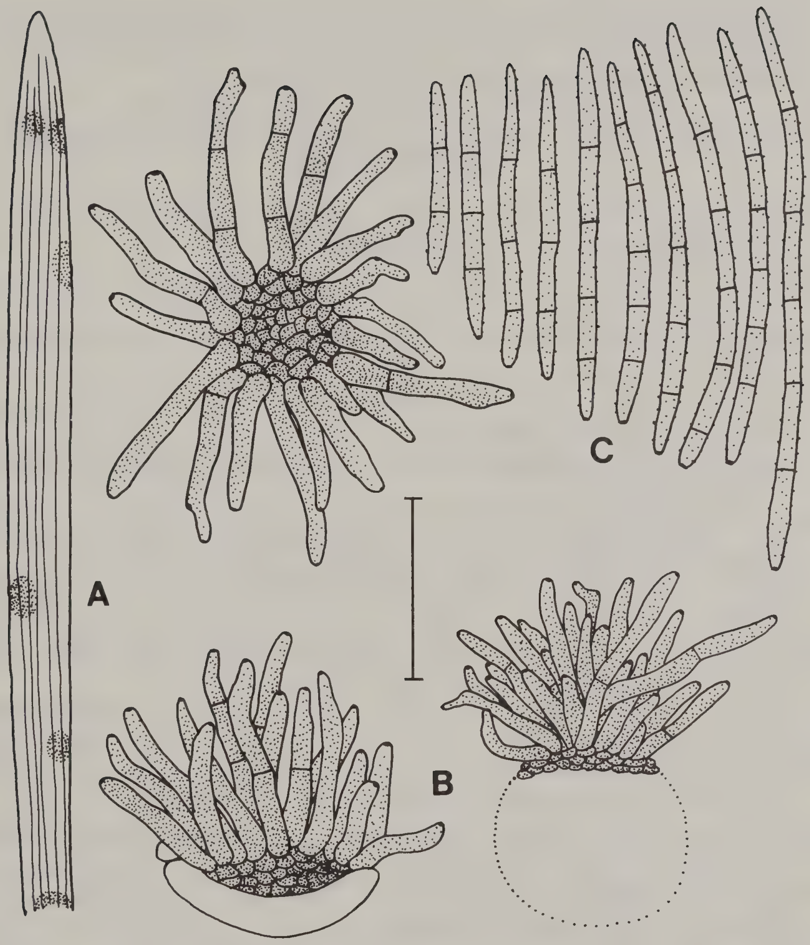

Fig. 5. *Stenellopsis liriopes* comb. nov.: **A.** Leaf spots on *Liriope platyphylla*; **B.** Conidiophores; **C.** Conidia. Bar = 30 µm. H.D. Shin del.

thickened, somewhat darkened, refractive. This species is *Stenella*-like, but without secondary mycelium. These features agree well with *Stenellopsis*, so that this species is transferred to the latter genus.

ACKNOWLEDGEMENTS

This study was partly supported by the Korea Science and Engineering Foundation (Grant No. 941-0600-043-2). Prof. P. W. Crous, University of Stellenbosch, South Africa, kindly reviewed the manuscript.

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MYCOTAXON

Volume LXXIV(1), pp. 119-129 January-March 2000

STUDIES IN NEOTROPICAL POLYPORES 5
NEW AND NOTEWORTHY SPECIES FROM PUERTO RICO AND VIRGIN ISLANDS

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ABSTRACT

17 polypores new to Puerto Rico are reported. *Diplomitoporus incisus* Ryvarden, *Tyromyces limitatus* Ryvarden and *Tyromyces nodulosus* Ryvarden are described as new. The combination *Diplomitoporus hondurensis* (Murrill) Ryvarden is proposed. The second known collection of *Hymenochaete raunkiaeri* Bres. is reported from the type locality on St. John, US Virgin Islands.

Key words: Polyporaceae, Puerto Rico, Virgin Islands.

Introduction

The fungi of Puerto Rico and the Virgin Islands are better known than for almost any neotropical area thanks to Stevenson´s comprehensive checklist (Stevenson 1975). Nevertheless, the recent intensive collecting under the Basidiomycetes of the Greater Antilles project has revealed many species hitherto not known from the island. These are reported below and specimens of all species are deposited in the herbarium UPRRP, CFMR besides duplicates in O, except for *H. raunkiaeri* from St. Johns which is deposited at NY.

CORTICIACEAE

Climacodon pulcherrimus (Berk. & W. A. Curtis) Nikolajeva
Luiza Pinones, at base of Cocalaba, 19. Nov. 1996, leg. E. Horak.
This is a beautiful white, pileate, strongly hydnoid species of uncertain taxonomic affinity, and its place in Corticiaceae is preliminary. In the field it is easily taken as a hydnoid representative of Hericiaceae. However, all species in this family have amyloid basidiospores. The species was originally described from North Carolina, United States, and is widespread in the subtropical and warm temperate zone.

GANODERMATACEAE

*Amauroderma schomburgkii (*Mont. & Berk.) Torrend
Luquillo Mts. Rio Grande, Palo Huaco, trail to El Cacique, 21. July 1999, S. A. Cantrell 9928, PR 5517.
This is a widespread and rather common species in South America, but known north to Cuba (Furtado 1981).

Ganoderma perzonatum Murrill
Cayey municipality, Carite Commonwealth Forest, 23. June 1996, Ryvarden 39013.
The species was originally described from Cuba and has not been reported since. This is not surprising since the taxonomy of the laccate species of *Ganoderma* has been in a chaotic state due to a proliferation of names (about 260 currently - see Moncalvo & Ryvarden 1998) and a complete lack of manuals with trustworthy characters.
Macroscopically this species is similar to *G. resinaceum* Boudier, a common species in the neotropics, but is separated by smaller basidiospores and finely encrusted apical cells in the cuticle.

HYMENOCHAETACEAE

Hymenochaete raunkiaeri Bres.
Virgin Island, St. John, Cinnamon Bay, 25. May 1994, D.J. Lodge St. J. no 129, NY.
The species was described from St. John in 1920 (Leger 1998), but has apparently not been reported since. It is recognized by a pale reddish brown, strongly resupinate and adnate basidiocarp and oblong, small and ellipsoid basidiospores.

Inonotus splitbergeri (Mont.) Ryvarden
Luquillo Mts., El Verde, 27. August 1993, Boyd & Lodge PR 1235.1.
Same locality, trail to Rio Sonadora, 24. Aug. 1993, M. Boyd & S. A. Cantrell CFMR-PR 1235.
This is a neotropical species which, to my knowledge, has not been reported from the Greater Antilles before, and the island of Puerto Rico seems to be its northernmost locality. The species is fairly common in the Amazonian basin and was described originally from Surinam.

POLYPORACEAE

Antrodiella liebmannii (Fr.) Ryvarden
Rio Grande, Big Tree Trail, 18. June 1996, Ryvarden 38930. Luquillo

Mts., Bisley Watershed, 6. June 1997, Ryvarden 40284, Guajataca, road near Magote Cerro Alto, Isabella, 27. June 1996, Ryvarden 39133.
A widespread pantropical species.

Antrodiella hydrophila (Berk.) Ryvarden
Luquillo Mts., El Verde Res. Area, above Control Center, 27. Aug. 1993, D. J. Lodge & M. Boyd, PR 1248; Toro Negro Comm. Forest, Cordillera Central, 24. June 1996, Ryvarden 39038; Guajataca, road near Magote Cerro Alto, Isabella 27. June 1996, Ryvarden 39102; Sabana Field Research Station, 22. November 1997, N. W. Legon PR 220.
A neotropical and fairly common species in the Caribbean, originally described from Cuba.

Antrodiella reflexa Lindblad & Ryvarden
Luquillo Mts., Bisley Watershed, 6. June 1997, Ryvarden 40320.
The species was recently described from Costa Rica (Lindblad & Ryvarden 1999) and is recognized by its pileate basidiocarps and tiny basidiospores, far smaller than for any other pileate *Antrodiella* species known from the neotropics.

Ceriporiopsis balanae Niemelä
Maricao Commonwealth Forest, 25. June 1996, Ryvarden 39076, Luquillo Mts., El Verde Station, 19. June 1996, Ryvarden 38966 and Luquillo, Bisley Watershed, 6. June 1997, Ryvarden 40288.
The species was originally described from Northern Canada (Niemelä 1985) and its was surprising to find it in a tropical environment like that of Puerto Rico. However, the collections have been compared with authentic material and their identities have also been confirmed by T. Niemelä. It is obvious that the species is hidden in some herbaria on the American mainland, either under "*Poria*" or is misfiled under different names. The white resupinate polypores are often notoriously difficult to determine.

Diplomitoporus hondurensis (Murrill) Ryvarden comb. nov.
Basionym: *Poria hondurensis* Murrill, Mycologia 12:303, 1920.
Luquillo Mts., Caribbean National Forest, Angelito trail, 8. June 1998, Ryvarden 40817.
Basidiocarps resupinate, up to 2 mm thick, adnate, brittle when dry, margin narrow, white to cream, pore surface white, pores angular, in

parts irregular and slightly incised, 2-4 per mm, in parts with hyphal pegs, some as hydnoid protuberances, others as an initial development of partition walls, tube layer concolorous with pores, up to 2 mm thick, subiculum very thin and white.

Hyphal system dimitic, generative hyphae hyaline, with clamps, 2-3 µm wide, skeletal hyphae predominant, solid to thick-walled, hyaline, negative in Melzer's reagent, 2-3 µm in diam. often mixed with coarse crystalline matter.

Cystidia and other sterile hymenial elements absent.

Dendrohyphidia present, both along the dissepiments where they are abundant and prominent, and among the basidia where they are smaller and with less apical protuberances.

Basidia 10-15 x 5-6 µm with basal clamps and 4 sterigmata, also observed with 2 sterigmata in the type.

Basidiospores oblong ellipsoid to cylindrical, thin-walled, negative in Melzer's reagent, 5-8 x 3-3.5 µm.

Type of rot. White rot.

Substrate. On dead hardwoods.

Distribution. Puerto Rico and Honduras (type locality), but certainly has a wider distribution in the Caribbean.

Remarks. The species is microscopically separated by the dendrohyphidia and larger basidiospores from the following species, *D. incisa*, which is macroscopically rather similar except that its pores are more irregularly incised.

The genus *Grammothele* is characterized by dendrohyphidia in both the hymenium and along the dissepiments. However, the genus is typified by *G. lineata* Berk. & Curtis, a rather distinct species having a deeply split hymenophore which is semiporoid to semihydnoid and dotted with numerous, strongly dextrinoid hyphal pegs that are initially hyaline, later becoming almost blackish, and then the basidiocarp looking almost like an old polypore attacked by a small pyrenomycete. Thus, it felt more natural to place *Poria hondurensis* in *Diplomitoporus* where the skeletal hyphae are non-dextrinoid and evenly distributed in the basidiocarp in all known species.

For the time being it is difficult to decide whether the dendrohyphidia should be given more taxonomic weight than other characters, but as the they are known from numerous corticoid and poroid genera, it seems reasonable to look upon them as secondary characters.

Diplomitoporus incisus Ryvarden nova sp.

Fructificatio resupinata, pori albidis, angulatis 1-3 per mm, tubi et contextibus albidis, systema hyphale dimiticum, hyphae generatoriae hyalinae, fibulatae, hyphae skeletales hyalinae, basidiosporae ellipsoideae, 5.5-6.5 (7) x 2.5-3 µm.

Holotype: Puerto Rico, Caribbean National Forest, El Verde Field Station, 19. June 1996, on dead hardwood tree, Ryvarden 38952 CFMR-PR-5471 and isotypes in UPRRP and O.

Etymology: incisus = deeply cut, referring to the incised pores.

Basidiocarps resupinate, up to 3 mm thick, adnate, brittle to tough when dry, margin narrow, white to cream, pore surface white to cream, pores irregular, sinuous, split and incised, 1-3 per mm, in some parts slightly more regular and 3-4 per mm, tube layer concolorous with pores, up to 4 mm thick, subiculum thin and white.

Hyphal system dimitic, generative hyphae hyaline, with clamps, 2-3 µm wide, skeletal hyphae predominant, solid to thick-walled, hyaline, negative in Melzer's reagent, 3-6 µm in diam.

Cystidia and other sterile hymenial elements absent.

Basidia 12-18 x 5-6 µm with basal clamps and 4 sterigmata.

Basidiospores oblong ellipsoid, hyaline, smooth, negative in Melzer's reagent, 5.5-6.5 (-7) x 2.5-3 µm.

Type of rot. White rot.

Substrate. On dead hardwoods.

Distribution. Besides the type locality also known from French Guiana (see below).

Remarks. The species is recognized by its white basidiocarp, the irregular split pores and the oblong basidiospores. *Diplomitoporus overholtsii* (Pil.) Gilb. & Ryvarden which is also known from Central America, has wider basidiospores, viz. 5.5-7 x 3.5-5 µm and more regular round pores. *Diplomitoporus dilutabilis* Loguercio-Leite & Wright recently described from Brazil (Loguercio-Leite & J.Wright 1998) has a trimitic hyphal system and allantoid basidiospores, thus different from the new species described here. *Diplomitoporus costaricensis* Lindblad & Ryvarden has much smaller pores, viz. 6-7 per mm and shorter basidiospores, viz. 4-4.5 x 2-2.5 µm. See comments under *D. honduerensis* above for differences with that species.

Besides these species, no other species of the genus have been reported from the neotropics although a small number of tentatively new species in the genus are under consideration.

Additional specimens examined. Puerto Rico The type locality, 27. August 1993, D. J. Lodge & M. Boyd, PR 1254, same locality 22 March 1994, H. H. Burdsall & D. J. Lodge, CFMR-PR 1467 (with culture), Chicken Farm, Sabana, 4. December 1997, N. W Legon PR 339, **French Guiana**: Upper Marouini River, 5 km WSW of Monpe Soula, August 1987, G. Samuels et al. 6170 (O, NY).

Hapalopilus albocitrinus (Petch) Ryvarden
Toro Negro Commonwealth Forest, 24. June 1996, Ryvarden 39044.
The deep yellow surface becoming reddish when dry makes this a distinct species. It is pantropical and was originally described from Sri Lanka, but again described by Murrill as *Poria rhoadsii* from Cuba.

Junghuhnia carneola (Bres.) Ryvarden
Luquillo Mts., Bisley Watershed, 8. June 1997, Ryvarden 40317, CFMR-PR 5457 with culture.
A widespread pantropical species. In fresh condition rather easy to recognize due to the pale citric yellow pore surface becoming reddish to pale brown when bruised or dried.

Junghuhnia minuta Lindblad & Ryvarden
Luquillo Mts., Bisley Watershed, H.H. Burdsall Jr. HHB-15018 PR 1513, 24. March 1994, same locality, 6. June 1997, Ryvarden 40279.
The species was recently described from Costa Rica (Lindblad & Ryvarden 1999) and is characterized by minute basidiospores and large encrusted cystidia.

Junghuhnia subundata (Murrill) Ryvarden
Sabana field station, 18. November 1997, N.W. Legon PR no 159.
A rare Caribbean species, originally described from Cuba.

Oxyporus populinus (Schum.:Fr.) Donk
Cayey municipality, Carite Commonwealth Forest, 23. June 1996, Ryvarden 39015; Luquillo Mts., Bisley Watershed, 6. June 1997, Ryvarden 40293.
This is an almost cosmopolitan species though in Africa and South America it is only collected in the mountains.

Trichaptum byssogenus (Jungh.) Ryvarden
El Verde Res. Area, 1993, M. Boyd PR 5509 CFMR and O.
This is a conspicuous species with a strigose pileus and angular large pores with a distinct violet to pink tinge when fresh. It is pantropical and was originally described from Java, Indonesia.

Trichaptum durum (Jungh.) Corner
Luquillo Mts., Bisley Watershed, H.H. Burdsall Jr, HHB-15010, O, CFMR, PR 1505 with culture, 24. March 1994, on dead *Casearia arborea*.

Tyromyces limitatus Ryvarden nova sp. Fig. 1A-D
Fructificatio pileata, pori brunneus, angulatis 7-9 per mm, contextibus duplex, ochraceous, systema hyphale monomiticum, hyphae generatoriae hyalinae, fibulatae, basidiosporae ellipsoideae, 3-3.2 x 2-2.4 µm.
Holotype: Puerto Rico, Rio Grande Mun., Luquillo Mounts. La Coca trail, 25. May 1997, S. A. Cantrell & D. Llorens, S. A. Cantrell 9746, PR-4578 in CFMR, isotypes in UPRRP and O.
Basidiocarp annual, pileate, spathulate to flabelliform, semicircular and up to 5 cm in diameter, and 4 mm thick at the base, soft when fresh, hard and brittle when dry and slightly curled due to some shrinking by drying, margin thin and entire, then partly split by drying, upper surface ochraceous to pale brown, dull, finely scrupose (lens) and faintly concentrically zoned, pore surface ochraceous when fresh, drying deeper brown, pores angular to round, thin-walled, invisible to the naked eye, 7-9 per mm, tubes concolorous with the pore surface up 2 mm deep and with a dense zone next to the context, context duplex, up to 3 mm thick, lower part up to 2 mm thick, cream to pale ochraceous, separated with a dense dark brown resinous line from the denser pilear cover, which is 0.5 mm thick at the base.
Hyphal system monomitic; generative hyphae with clamps, thin- to very thick-walled, 3-10 µm wide measured in 3% KOH with large conspicuous clamps
Cystidioles present in the hymenium, sharply pointed, smooth, thin-walled and hyaline, up to 15 µm long and 5 µm wide in the middle.
Basidia clavate, with 4 sterigmata, 12-15 x 4-5 µm with a basal clamp.
Basidiospores ellipsoid, hyaline, IKI-, 3-3.2 x 2-2.4 um.
Substrata. Dead hardwood log.
Distribution. Known only from the type locality.
Remarks. This is a remarkable species with its distinct duplex context, a character not previously reported from *Tyromyces*. The upper pilear cover is probably soft and pliable when fresh drying hard and finely scrupose with distinct tufts of agglutinated hyphae. The very wide and thick-walled generative hyphae in the context are also striking.

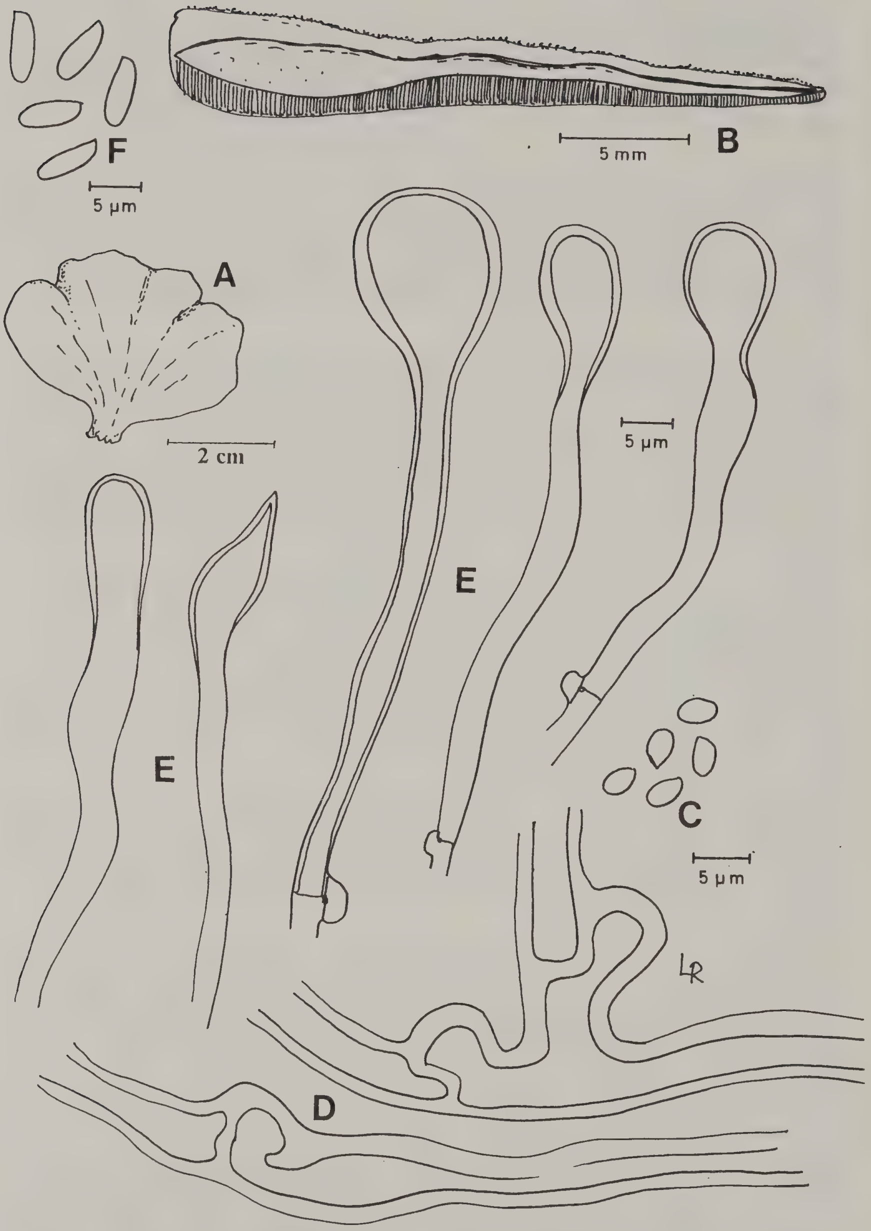
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Fig. 1 *Tyromyces limitatus* A) basidiocarp seen from above, B) section through basidiocarp, C) basidiospores, D) generative hyphae from the context, *T. nodulosus* E) cystidia, F) basidiospores. From the holotypes.

Tyromyces nodulosus Ryvarden, nova sp. Fig 1 E-F.
Fructificatio pileata, pori albidis, angulatis 3-4 per mm, tubi et contextibus albidis, systema hyphale dimiticum, hyphae generatoriae hyalinae, fibulatae, hyphae skeletales hyalinae, cystidia hyalinae, laeves, tubuliforma, basidiosporae cylindricae, 5-6 (7) x 1.5-2 µm
Holotype: Puerto Rico, Mayaguez municipality, University of Puerto Rico, between road and Finanzas Bldg., 4 Sept. 1998, on bark of living tree causing a white rot, A. M. Nieves-Rivera, PR 5292,(CFMR, isotypes in UPRRP and O).

Basidiocarp annual, pileate, nodulose with several sloping pilei in long vertical rows, individual pilei projecting up to 1 cm from the substrate and 1.5 cm thick at the base, fragile when dry, upper surface whitish, pressed velutinate, azonate, margin rounded, pore surface white when fresh, drying cream, pores angular to round, 3-4 per mm, tubes cream, up to 2 mm deep, drying fragile, context soft and fibrous, cream, 1 cm thick.

Hyphal system dimitic; generative hyphae with clamps, thin-walled, 2-6 µm wide, skeletal hyphae present only in the context, hyaline, straight and thick-walled when observed in 3% KOH, less so in Melzer´s reagent in which they are without reaction.

Cystidia present in dissepiments as apically widened hyphal ends, club shaped to distinctly bulbous, apical part up to 15 µm in diameter and with thickened walls, hyaline, up to 120 µm long to the basal clamps from which they arise, negative in Melzer´s reagent.

Basidia clavate, 15-22 x 5-6 µm with 4 sterigmata.

Basidiospores cylindric, hyaline, thin-walled, 5-6 (7) x 1.5-2 µm, negative in Melzer´s reagent.

Substrata. On the bark of living tree of unknown identity.

Distribution. Known only from the type locality.

Remarks. The species is recognized by its nodulose habitat giving it an appearance of a badly developed specimen of *Trametes* species until a microscopical examination is undertaken and the conspicuous cystidia are observed. The cystidia are larger though somewhat reminiscent of those of many *Hyphodontia* species, but the hyphal system of this corticoid genus is grossly different from that observed in this new species.

Wrightoporia bracei (Murrill) Ryvarden
Guajataca Commonwealth Forest, Verada Nueva trail, 26. June 1996, Ryvarden 39094, CFMR-PR 5516.
The species was described originally from the Bahamas, but has later

been found also in Costa Rica (Lindblad & Ryvarden 1999). It is fairly easy to recognize in the field due to its pale vinaceous colour, soft consistency and being conspicuously easy to loosen from the substrate.

Wrightoporia tropicalis (Cooke) Ryvarden
Luquillo Mts. Caribbean National Forest, Angelito trail 8. June 1998. Ryvarden 40847.
The collection is slightly atypical as the pores are partly sinuous and irregular in contrast with specimens seen from the Amazonian basin which have round pores, 6-7 per mm.
As the microscopical characters are identical with that of the type from Brazil, it is too early to decide whether the irregular pores are taxonomically significant or only represent an aberration.

Acknowledgements

The field work in Puerto Rico was funded under the US National Science Foundation Biotic Surveys Inventories Programme BS NSF DEB-9525902 with additional support from the International Inst. of Tropical Forestry. N. Legon, Kew Gardens, London, kindly sent his polypores from Puerto Rico for identification. Dr. D. J Lodge of USDA, Forest Service Center for Forest Mycology Research in Puerto Rico and Dr. T. Baroni of State Univ. New York, Cortland, organized the project and took care of all practical details and their enthusiasm and support are deeply acknowledged. Dr D. J. Lodge has also read the manuscript and provided constructive comments while Dr. T. Niemelä, University of Helsinki, Finland, has kindly confirmed the determination of *Ceriporiopsis balanae* and sent authentic material as well.

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MYCOTAXON

Volume LXXIV(1), pp. 131-134 January-March 2000

UREDO THELYPTERIDIS VAR. STIPITATA VAR. NOV.

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SUMMARY

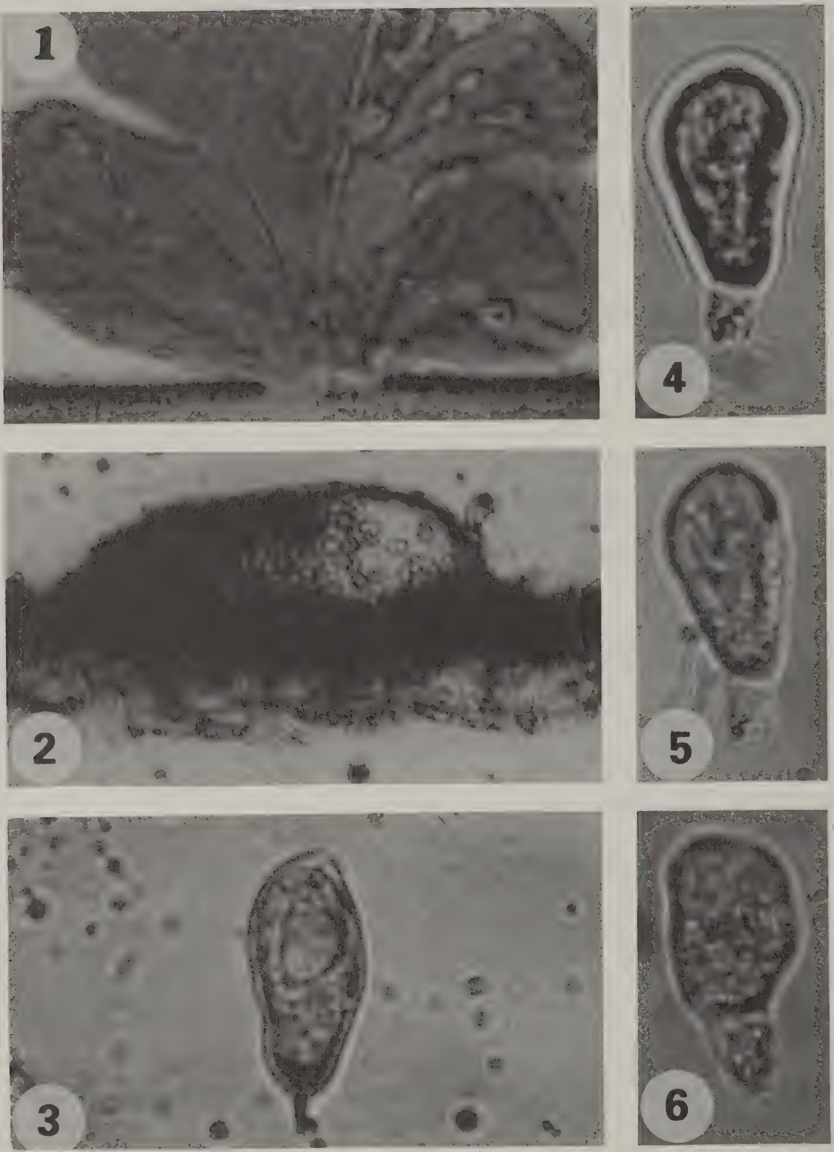
A new variety of *Uredo thelypteridis* Yadav (*Uredo thelypteridis* Yadav var. *stipitata* De, var.nov.) is described and illustrated. The fungus was found growing on the leaves of the fern *Pseudophegopteris aurita* (Hook.) Ching. at Darjeeling, West Bengal, India.

During a survey of fungi of the Indian Eastern Himalayas in October 1990 a rust fungus was collected growing on the leaves of *Pseudophegopteris aurita* at Darjeeling (altitude 2100 m), West Bengal, India. The morphology of this fungus resembled closely *Uredo thelypteridis* Yadav (Yadav 1964) yet differed strikingly from *U. thelypteridis* by the presence of a stipe of its urediniospores and their smaller size. Therefore, a new variety *Uredo thelypteridis* Yadav var. *stipitata* De is being proposed to accommodate this fungus.

Uredo thelypteridis Yadav var. *stipitata* De, var.nov.

Urediniis amphigenis, minutis, sparsis, subepidermalibus, erumpentibus, pulverulentibus, aureoluteis vel pallide luteis, ovatis, peridio rudimentario; urediniosporis ovatis vel ellipsoideis, membrana 0.8-1.0 µm crassa, aureoluteis vel pallide luteis, laevi, poris germinationis inconspicuis, 15-25 X 8-12 µm, stipitatis, stipe 3.5-5.5 X 1.5-2.5 µm, persistenti; paraphysibus nullis.
HOLOTYPUS: Foliis vivis *Pseudophegopteridis auritae,* Darjeeling, West Bengal, India, die 20 Octobri, 1990. Typus positus in herbario fungorum in sectio Botanicae, Burdwan Raj College, Burdwan, West Bengal, India (sub numero BRCMH U901); in herb Kew conservatus [isotypus: K(M)17940].

Uredinia (Fig.1) amphigenous, minute, scatttered, subepidermal (Fig.2), erumpent, pulverulent, golden-yellow to pale yellow, oval, peridium rudimentary; urediniospores (Figs.3 - 6) oval to ellipsoid, wall 0.8-1.0 µm thick, golden-yellow to pale yellow, smooth with hyaline content, germpores inconspicuous, 15-25 X 8-12 µm, stipitate, stipe 3.5-5.5 X 1.5-2.5 µm, persistent; paraphyses absent.
HOLOTYPE : On living leaves of *Pseudophegopteris aurita* Darjeeling, West Bengal,



Figs. 1-6. *Uredo thelypteridis* var. *stipitata* (holotype): 1. Infected leaflet of *Pseudophegopteris aurita* showing uredinia (x 9); 2. transverse section of leaflet of *P.aurita* showing subepidermal urediniospores and rudimentary peridium (x 120); 3 – 6. Urediniospores (x 1300).

India, October 20, 1990. The type specimen is deposited in the Mycological Herbarium, Department of Botany, Burdwan Raj College, Burdwan, West Bengal, India (BRCMH U901). A portion of the specimen has been deposited in the Kew Herbarium, Richmond, Surrey, England [isotype: K (M) 17940].

DISCUSSION

In fungi with several stages of development to which different names have been given, the species epithet that is to be retained is the one applied to the "perfect" stage of the fungus, regardless of the fact that names may have been given earlier to some other stages. But "perfect" stage of many fungi are unknown. They are grouped on the basis of the characteristic features of their "imperfect" stage into different genera with the prefix "form" to denote their artificial nature. But due to lack of information about the "perfect" stage it has not been possible to ascertain their natural relationship. Such is the case for many rust fungi, especially in warm countries, which persist in the uredinial stage and form no other stages. These have been placed in the genus *Uredo* Pers. (Laundon, 1973). Thus, *Uredo* consists of species of which the uredinial stage, an imperfect stage, only is known. Accordingly, the taxon described here has been placed in the genus *Uredo*. *Uredo* may be the uredinial stage of several rust genera such as *Puccinia, Uromyces, Phakopsora, Phragmidium* etc. In many of the species included in *Uredo* there are probably other stages besides the uredinial stage which are yet unknown or the connection between the stages has not yet been established. It is also possible that in some of these species the other stages have been omitted during the course of evolution.

The taxon described here shows some relationship with the members of the genus *Hyalopsora* Magn., bearing rudimentary peridium, yellow uredinia on ferns and smooth-walled urediniospores. But it differs markedly from the genus *Hyalopsora* in having urediniospores with golden-yellow to pale yellow wall, hyaline content and inconspicuous germpores. It shows close resemblance with *Uredo thelypteridis* Yadav (whose type host is *Thelypteris* sp.) possessing minute amphigenous scattered subepidermal golden-yellow to pale yellow uredinia on fern leaves with rudimentary peridium and golden-yellow to pale yellow non-paraphysate smooth oval urediniospores with inconspicuous germpores. Therefore, it has been considered as conspecific to *Uredo thelypteridis*. But urediniospores of the examined specimen [K (M) 17940] are much smaller than those of Yadav (1964). Besides, the urediniospores of the taxon described here are stipitate while those of *U. thelypteridis* described by Yadav (1964) are sessile. Due to these differences with *U. thelypteridis* I have described the specimen as a new variety of *Uredo thelypteridis* Yadav and I have proposed the name of this new variety as *Uredo thelypteridis* Yadav var. *stipitata* De.

Erection of the variety *U. thelypteridis* Yadav var. *stipitata* De has automatically established the name of another variety *Uredo thelypteridis* Yadav *thelypteridis* (Art. 26.3 Ex.4, ICBN 1994). These two taxa can be distinguished by the following features:

Urediniospores sessile, 20-38 X 11-19 μm

U. thelypteridis var. *thelypteridis*

Urediniospores with well defined stipe, 15-25 X 8-12μm (excluding stipe)

U. thelypteridis var. *stipitata*

ACKNOWLEDGEMENT

The author is greatly indebted to Dr. Stephan Helfer, Royal Botanic Garden, Edinburgh, Scotland, U.K. for critically reviewing the manuscript.

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MYCOTAXON

Volume LXXIV(1), pp. 135-140 January-March 2000

NEW XYLARIACEOUS FUNGI FROM MALAYSIA

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ABSTRACT

Four new xylariaceous fungi from Malaysia are described, including one species of ***Biscogniauxia***, one of ***Hypoxylon***, and two of ***Xylaria***.

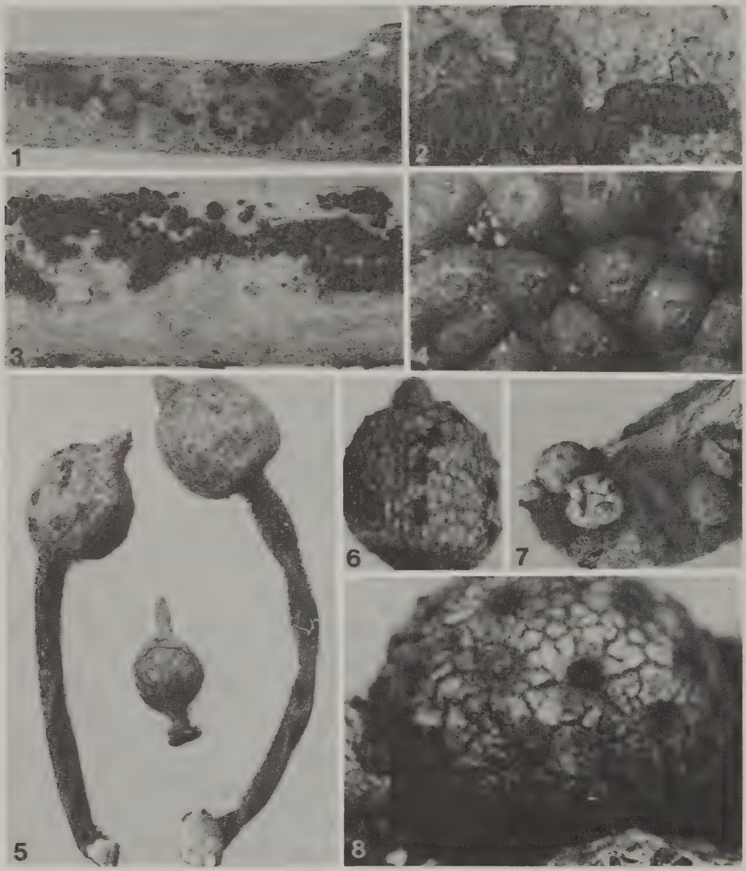
Key words: ***Biscogniauxia***, ***Hypoxylon***, systematics, ***Xylaria***, Xylariaceae

The new xylariaceous taxa described herein represent collections made by MAW in 1993 and 1995.

Biscogniauxia nawawii M. A. Whalley, Y.-M. Ju, J. D. Rogers, & A. J. S. Whalley, *sp. nov.* Figs. 1, 2, 9

Etymology: in honor of Prof. Nawawi, Department of Botany, University of Malaysia

Stromata applanata, 1-13 mm diam x 0.3-0.5 mm crassa; stratum externum dehiscens rufobrunneum tenue; superficies matura fusca; textura proxime sub superficie et inter perithecia carbonacea; textura sub peritheciis inconspicua. Perithecia globosa, 0.1-0.2 mm diam. Ostiola plus minusve papillata. Asci uniseriate octospori, cylindrici, 70-90 μm longitudine tota x 7-8 μm crassi, partibus sporiferis 55-70 μm longitudine, stipitibus 10-25 μm



Figs. 1-8. ***Biscogniauxia nawawii***, ***Hypoxylon gombakense***, ***Xylaria maraca***, and ***X. fraseri***. 1, 2. ***B. nawawii*** (holotype). 1. Stromata; X1. 2. Stromatal surface; X6. 3, 4. ***H. gombakense*** (holotype). 3. Stromata; X1. 4. Stromatal surface; X16. 5, 6. ***X. maraca*** (holotype). 5. Stromata; X4. 6. Stromatal surface; X6. 7, 8. ***X. fraseri*** (holotype). 7. Stromata; X1.33. 8. Stromatal surface; X10.

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longitudine, parte infima annuli apicalis in liquore iodata Melzeri cyanescente, discoideo, 1.5 μm alto x 4.5 μm lato. Ascosporae fuscae, unicellulares, subglobosae, equilaterales apicibus latis, leves, 7.5-8.5 x 6-7 μm, rima germinativa cingenti praeditae.

Stromata applanate, 1-13 mm diam x 0.3-0.5 mm thick; outer dehiscing layer dull copper brown, thin; mature surface dark brown; carbonaceous immediately beneath surface and between perithecia; tissue beneath perithecia inconspicuous. Perithecia globose, 0.1-0.2 mm diam. Ostioles slightly higher than stromatal surface with openings papillate. Asci cylindrical, with eight ascospores arranged in uniseriate manner, 70–90 μm total length x 7-8 μm broad, the spore-bearing parts 55-70 μm long, the stipes 10–25 μm long, with lower portion of apical ring bluing in Melzer's iodine reagent, discoid, 1.5 μm high x 4.5 μm broad. Ascospores blackish brown, unicellular, subglobose, equilateral, with broadly rounded ends, smooth, 7.5-8.5 x 6-7 μm, with straight germ slit spore-length on both sides.

SPECIMEN EXAMINED: MALAYSIA: Selangor Prov., FRIM, 14.IV.1995, Whalley, M. A. FR20-95, fallen twig (WSP, HOLOTYPE of ***Biscogniauxia nawawii***).

NOTES: Ascospores with the germ slit on both sides can also be found in ***B. albosticta*** (Ellis & Morg.) Y.-M. Ju & J. D. Rogers, ***B. cinereolilacina*** (J. H. Miller) Pouzar, ***B. querna*** Pouzar, ***B. repanda*** (Fr.: Fr.) Kuntze, and ***B. schweinitzii*** Y.-M. Ju & J. D. Rogers (Ju et al., 1998). The present fungus has smaller, darker ascospores than these species. In addition, the present fungus differs from ***B. albosticta*** in having papillate ostiolar openings and in having globose ascospores; from ***B. cinereolilacina*** in having dark brown stromatal surface, in having carbonaceous tissue homogeneously distributed beneath surface and between perithecia, and in having globose ascospores; from ***B. querna*** in having applanate stromata and in having ascospores not laterally compressed; from ***B. repanda*** in having applanate stromata with carbonaceous tissue homogeneously distributed beneath surface and between perithecia and in having globose ascospores; and from ***B. schweinitzii*** in having papillate ostiolar openings and in having ascospores not laterally compressed.

Hypoxylon gombakense M. A. Whalley, Y.-M. Ju, J. D. Rogers, & A. J. S. Whalley, *sp. nov.* Figs. 3, 4, 10

Etymology: after the locality

A Hypoxylo micheliani differt in superficie fusca et hospite graminis.

Stromata effused-pulvinate, with perithecial mounds 1/2-2/3 exposed, ca. 1 mm thick; surface dark reddish brown; blackish granules immediately beneath surface, with KOH-extractable pigments isabelline (65)*; the tissue below the perithecial layer inconspicuous. Perithecia spherical, 0.7-0.9 mm diam. Ostioles slightly papillate, encircled with a *truncatum*-type disc (as defined in Ju and Rogers, 1996) 0.2 mm diam. Asci cylindrical, with eight ascospores arranged in uniseriate manner, 145-165 μm total length x 6-7.5 μm broad, the spore-bearing parts 100-110 μm long, the stipes 45-60 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5-1 μm high x 2-2.5 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 13-15 x 5-6 μm, with straight germ slit spore-length on the convex side; perispore dehiscent in 10% KOH,

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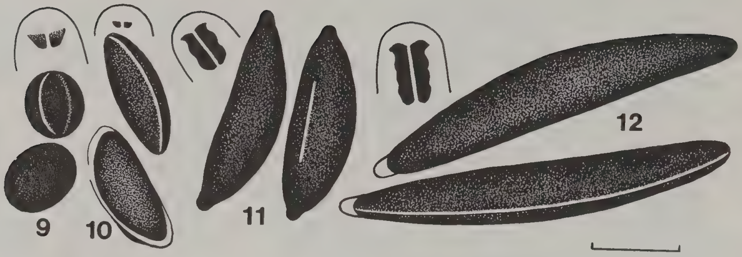
* The color code follows Rayner (1970).



Figs. 9-12. Ascal apical rings and ascospores. 9. ***Biscogniauxia nawawii*** (holotype). 10. ***Hypoxylon gombakense*** (holotype). 11. ***X. fraseri*** (holotype). 12. ***Xylaria maraca*** (holotype). The scale bar represents 10 μm.

smooth, with a thickened area visible at the position of ca. 1/3 ascospore length on the same side as the germ slit; epispore smooth.

SPECIMEN EXAMINED: MALAYSIA: Selangor Prov., Gombak, 23.II.1993, Whalley, M. A. G13-93, bamboo culm (WSP, HOLOTYPE of ***Hypoxylon gombakense***).

NOTES: This bamboo-inhabiting ***Hypoxylon*** is undoubtedly a member of section ***Annulata***. ***Hypoxylon michelianum*** Ces. & De Not., which is known from southern Europe, is similar in ostiolar disc size and ascospore size range but differs in having whitish stromatal surface, in having conspicuous stromatal tissue beneath the perithecial layer, in not being associated with bamboo, and in having somewhat smaller perithecia.

Xylaria maraca M. A. Whalley, Y.-M. Ju, J. D. Rogers, & A. J. S. Whalley, *sp. nov.* Figs. 5, 6, 12

Etymology: refers to its resemblance to a maraca

A Xylaria squamulosa differt in apice sterili acuto, in squamis ochraceis, et in latitudine ascosporarum.

Stromata unbranched, capitate, with acute sterile apices, on slender pubescent stipes, the fertile parts 2.5-4 mm diam, the stipes 2-12 mm long x 0.5-1 mm thick; surface black, smooth, overlain with dull ochraceous peeling layer cracked into scales; carbonaceous immediately beneath surface; whitish, hard between and beneath perithecial layer. Perithecia spherical, 0.4-0.6 mm diam. Ostioles papillate. Asci cylindrical to clavate, with eight ascospores arranged in partially biseriate manner, 240-265 μm total length x 13.5-15 μm broad, the spore-bearing parts 165-180 μm long, the stipes 70-85 μm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, with two or three constrictions, 7-8 μm high x 4.5-5 μm broad. Ascospores dark brown, unicellular, fusoid-inequilateral, with narrowly rounded ends, usually bearing a cellular appendage on one end, 39-50 x 6-8 μm, with straight germ slit spore-length on the convex side.

SPECIMEN EXAMINED: MALAYSIA: Pahang Prov., Fraser's Hill, 1997, Whalley, M. A. FH9-97, barked stolon (WSP, HOLOTYPE of ***Xylaria maraca***).

NOTES: This fungus features globose fertile parts covered with dull ochraceous scales and fusoid ascospores with the long germ slit on the convex side. A cellular appendage can usually be found on the ascospore. ***Xylaria squamulosa*** San Martín & J. D. Rogers (San Martín and Rogers, 1989) also has rounded fertile parts but differs in lacking sterile apices, in having whitish scales, and in having broader ascospores.

Xylaria fraseri M. A. Whalley, Y.-M. Ju, J. D. Rogers, & A. J. S. Whalley, *sp. nov.* Figs. 7, 8, 11

Etymology: after Louis James Fraser, an old recluse and ore trader, who established the hill settlement where this fungus was collected

A Xylaria areolata differt in amplitudine ascosporarum, in ascosporis cum apicibus acutis et rima germinativa brevi.

Stromata hemispherical to depressed-spherical, attached to substrate with narrow connectives, 3-5 mm diam x 1.5-4 mm high; surface plane, overlain with white to yellowing white peeling layer cracked into 0.2-0.4 mm broad scales; carbonaceous immediately beneath surface; whitish, corky between and beneath perithecial layer. Perithecia spherical, 0.6-0.8 mm diam. Ostioles papillate. Asci cylindrical, with eight ascospores arranged in uniseriate manner, 195-220 μm total length x 9-11 μm broad, the spore-bearing parts 115-140 μm long, the stipes 80-100 μm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, with two constrictions, 4.5-5 μm high x 3.5-4 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, with abruptly pinched ends, 22-24.5 x 6.5-7.5 μm, with straight germ slit much less than spore-length on the flattened side.

SPECIMEN EXAMINED: MALAYSIA: Pahang Prov., Fraser's Hill, 19.IV.1995, Whalley, M. A. FH39-95, twigs (WSP, HOLOTYPE of ***Xylaria fraseri***).

NOTES: This fungus is characterized by penzigioid stromata and whitish scales on the stromatal surface. The stromata highly resemble those of ***X. areolata*** (Berk. & M. A. Curtis) Y.-M. Ju & J. D. Rogers [CUBA: Wright, C. 586, Fung. Cub. Wright. 824, corticated wood (FH [2pks.], ISOTYPE of ***Hypoxylon areolatum*** Berk. & M. A. Curtis)] and ***Penzigia cantareirensis*** (Henn.) J. H. Miller [BRAZIL: São Paulo, Serra da Cantareira, 1902, Puttemans, decorticated wood (S, LECTOTYPE of ***Hypoxylon cantareirense***)]. ***Xylaria areolata*** differs from the present fungus in having larger ascospores, 28-33 x 8.5-10 μm, with broadly rounded ends, a noncellular appendage on each end, and a nearly spore-length germ slit. ***Penzigia cantareirensis*** differs in having larger ascospores, 25-32 x 9.5-11 μm, with narrowly rounded ends that are not pinched and a spore-length germ slit. ***Xylaria cranioides*** (Sacc. & Paol.) Dennis and ***X. cretacea*** Berk. & Broome also have penzigioid stromata with the surface covered with a whitish layer. However, these two ***Xylaria*** species have much larger stromata, one or more centimeters in diameter, and have larger ascospores.

ACKNOWLEDGMENTS

JDR and YMJ thank National Science Foundation Grant DEB-9813304 for support of this study. We thank Frank Dugan, Pullman, WA, and Dean A. Glawe, Puyallup, WA, for reviewing the manuscript.

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MYCOTAXON

Volume LXXIV(1), pp. 141-151 January-March 2000

ON THE PRESENCE OF RAMALINA COMPLANATA (RAMALINACEAE, LICHENIZED ASCOMYCOTINA) AND ALLIED SPECIES IN ARGENTINA

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Abstract - Argentine specimens referred in the literature to as **R. complanata** (Sw.) Ach. and **R. asperula** do not belong to those species but to **R. aspera** Räsänen. Two of the three chemical races known for **R. aspera** were found in Argentina: the divaricatic acid race and the boninic acid race, the latter being reported for South America for the first time. **R. subfraxinea** Nyl., a tropical species closely related to **R. aspera**, is also still unknown to Argentina. Main features to distinguish the mentioned taxa are the kind of thallus surface, pseudocyphellae, chondroid tissue and medullary substances.

INTRODUCTION

Ramalina Ach. includes ca. 200 fruticose species with cylindrical to flattened, solid to hollow thallus, lecanorine apothecia and colorless, bicellular, ovoid to ellipsoidal ascospores (Galloway 1985). There is a world monograph of the genus, made more than a century ago (Nylander 1869). Most of subsequent taxonomic works on ***Ramalina***, although numerous, are local or regional revisions (Malme 1934; Krog & Swinscow 1974, 1975; Krog & Osthagen 1980; Stevens 1987a-b; Kashiwadani 1987a-c, 1990; Kashiwadani & Kalb 1993).

Grassi (1950) cites 22 species to Argentina, and Osorio (1970a) adds another species. The present work deals with four species, which are studied comparatively: ***Ramalina complanata*** (Sw.) Ach. and ***R. asperula*** Krempelh., the only species of the group previously cited for Argentina; ***R. aspera*** Räsänen, because the first specimens studied by the authors belong to this species; and ***R. subfraxinea*** Nyl., because of a specimen in BAFC referred to this taxon. Main common features are: solid, flattened thallus, orbicular pseudocyphellae, terminal apothecia, and absence of vegetative propagules.

MATERIALS AND METHODS

More than 140 specimens were examined, including material collected by the authors in Buenos Aires and Entre Ríos Provinces (BAFC, LPS and Herb. Scutari) as well as specimens deposited in other herbaria (BRI, CTES, H, LIL, M, Herb. Osorio, S, TNS and TUR). Sections were made from dried material, using a razor blade and a dissecting microscope. Because of being fragile, thallus sections were transferred to clean slides (1-3 sections per slide), covered with coverslips, which were fixed with glue by one angle, and embedded with lactophenol cotton-blue. After two or three days, preparations were observed to check the degree of staining. Air bubbles were removed by gentle heating (abrupt removal of bubbles may break sections). For spore measurements, sections were mounted in water. Spot tests were made with 10% KOH (***K***) on thallus surface and medulla. Further chemical analyses were carried out by TLC according to current techniques (Culberson & Kristinsson 1970; Culberson 1972; White & James 1985).

RESULTS

The Argentine material examined here includes ***a)*** most of the specimens cited in the literature as ***Ramalina complanata*** (Sw.) Ach. (Grassi 1950; Osorio 1968, 1969, 1970a, 1975, 1976, 1981, 1982; Osorio & D'Espósito 1979); ***b)*** a single specimen reported as ***R. asperula*** Krempelh. (Grassi 1950); ***c)*** a specimen in BAFC provisionally referred to ***R. subfraxinea*** (Kashiwadani, in litt.); ***d)*** own collections. Morphology and chemistry of all specimens agree with that of ***R. aspera*** Räsänen. They belong to the divaricatic acid race, except for a recent collection (LPS 45496; Concordia, Entre Ríos) and the specimen in M (Lorentz & Hieronymus, s/n; no locality cited), wrongly identified with ***R. asperula*** (Krempelhuber 1878).

Only some Brazilian specimens belong to ***R. complanata***; the remaining South American material revised here is referred to as **R. aspera**. The species is described below.

Ramalina aspera Räsänen, *Ann. bot. Soc. zool. bot. fenn. Vanamo* **20:** 5 (1944). *Type collection*: Paraguay, Chaco, Río Verde, Villa Hayes, *W. Herter 3* (H - holotype). *Synonyms:* cfr. Kashiwadani & Kalb (1993). Figs. 1-2.

Thallus corticolous, light greenish, erect, 2,5-4 cm long, dichotomous to subdichotomous, scarcely to moderately branched, surface rugose to reticulate, pseudocyphellae orbicular, tuberculate, laminar and marginal. Lacinae flattened, solid, 0,2-0,6 (-0,7) cm width. Cortex 20-25 µm thick, with a thin epinecral layer of regular thickness; chondroid tissue irregular in thickness (30-50 µm), not cracked. Isidia and soredia absent. *Apothecia* subterminal to terminal, 0,3-0,9 mm diám., margin entire, pseudocyphellate, with or without spurs, discs whitish-green, concave to flat, ascospores elliptical-fusiform, straight to slightly curved, 12-14 x 3,5-5 µm. *Chemistry.* Race 1: usnic acid (cortex) and divaricatic acid (medulla); race 2: usnic acid and substances in the boninic acid aggregate (boninic, 2'-0-metilsekikaic and 4'-0- metil-paludosic acids).

Representative specimens examined: ***Ramalina aspera:*** **ARGENTINA**, leg. Lorentz & Hieronymus, no locality cited (M; as ***R. asperula*** Krempelh.). ***BUENOS AIRES PROVINCE**, Berisso Department,* Balneario La Balandra, 14-III-1996 on *Gleditsia triacanthos,* N. Scutari & V. Rosato 20 (herb Scutari 255; LPS 45488, dupl.). *Ensenada Department,* Punta Lara, Possiel 64 (Herb. Osorio 1230), Fernández Lima 15 (Herb. Osorio 1238), Osorio 5845 (Herb. Osorio); 20-VIII-1995, N. Scutari & V. Rosato 15 (herb. Scutari 256; LPS 45489, dupl.). *Martín García Island,* Forest path, close to the Monument to the "Héroes Comunes de los dos Pueblos", 16-VIII-1997, on *Acacia caven,* N. Scutari & V. Rosato 35, 36, 37 (herb. Scutari 257 A-C; LPS 45490, 45491, 45492, dupl.). *Magdalena Department*, Atalaya, May 1995, on *Salix* sp., V. Rosato 9 (herb. Scutari 258; LPS 45494, dupl.). *Zárate Department,* Zárate, 10-V-1971, on bark, leg. G. Kuperschimit (BAFC 35535). *ENTRE RÍOS PROVINCE, Gualeguaychú Department,* Gualeguaychú, "Reserva El Ñandubayzal", 26-IV-1996, on *Erythrina crista-gallii, N. Scuta-*

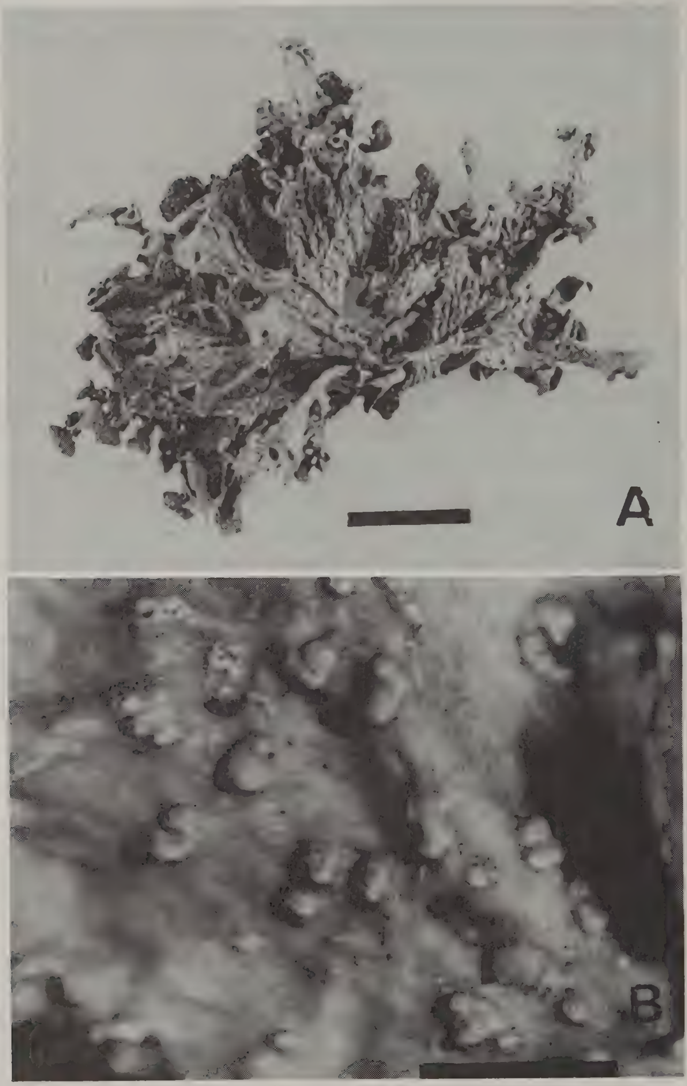

Fig. 1. ***Ramalina aspera*** Räsänen (Buenos Aires, Balneario La Balandra, herb. Scutari 255). **A**: Habit; scale: 5 mm. **B**: Detail of tuberculate pseudocyphellae; scale: 0.6 mm.

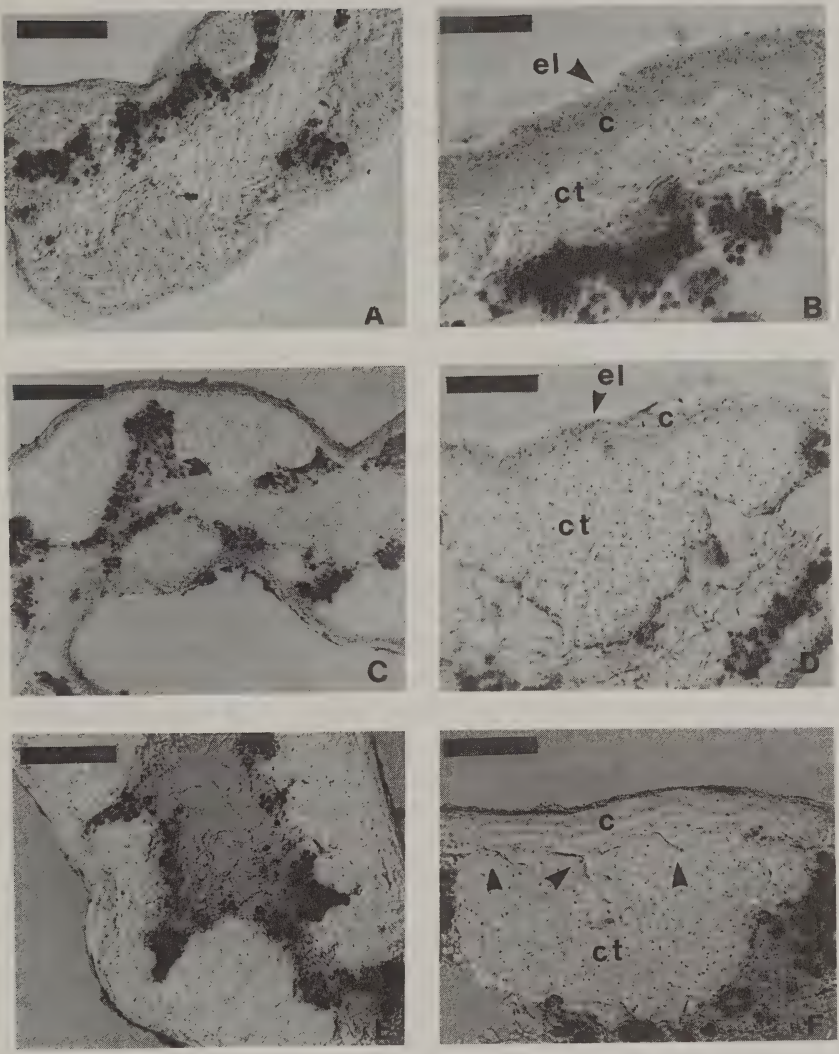

Fig. 2. ***Ramalina aspera*** and some related species, cross thallus sections. **A, C, E:** general views; scales: 100 µm. **B, D, F:** details of chondroid tissue; scales: 50 µm. **A-B:** ***R. aspera*** (Buenos Aires, Balneario La Balandra, herb. Scutari 255). **C-D:** ***R. subfraxinea*** (Ecuador, TNS 492340); note the similarity with ***R. aspera***. **E-F:** ***R. complanata*** (Sw.) Ach. (Río de Janeiro, Malme 371; S); note the cracked chondroid tissue (arrows). *c*= cortex; *ce*= epinecral layer; *ct*= chondroid tissue.

ri &V. Rosato 23 (herb. Scutari 259; LPS 45495, dupl.). *Concordia Department*, nat. route n° 12, 25 Km. northwards from Concordia City, Nov. 1995, on fence post, *V. Rosato 17* (LPS 45496). *Diamante Department*, Diamante, "Pre-Delta" National Park, 20-IV-1997, *N. Scutari & V. Rosato 24 & 25* (herb. Scutari 261 A-B; LPS 45497, 45498, dupl.).***CÓRDOBA PROVINCE***, 10 Km. southwards from La Para, August 1995, *leg. C. Estrabou* (herb. Scutari 262). ***CORRIENTES PROVINCE***, *Sauce Department*, Cañaditas stream, 25 Km. southwest from Sauce, "Estancia Coem-botá", 18-VIII-1992, *Ferraro 4204* (CTES). *Monte Caseros Department*, Uruguay river, Itacumbú Island, close to Monte Caseros, eastern coast, 20-XII-1977, *Irigoyen 442* (CTES). *San Martín Department*, "Arrocera Drews", 8 Km. northwards from Pellegrini, 21-II-1976, in a "ñandubay" forest, *Ferraro et al. 964* (CTES). *Empedrado Department*, "Estancia Las Tres Marías", 21-VIII-1979, on *Astronium balansae, Schinini 19790* (CTES). *Goya Department*, "Colonia San José", 20 Km southwards from Goya City, 27-XI-1979, on bark, in a degraded "quebrachal", *Schinini 19745* (CTES). *San Miguel Department*, Caá-Catí, 17-III-1978, on *Lithraea molleoides, Ahumada 2470* (CTES). *Berón de Astrada Department*, 33 Km. from Itá-Ibaté, nat. route n° 12, 24-VIII-1978, on fence post, close to the route, *Ferraro 1362* (CTES). ***CHACO PROVINCE***, *Donovan Department*, 13 Km. northwards from La Verde, "Estancia Dos Tranqueras", 21-VIII-1987, on *Prosopis alba, Schinini 22788* (CTES). *La Leonesa Department*, between Cangüi Grande stream and the path, 16-XI-1995, *Ferraro et al. 5256* (CTES). *1° de Mayo Department*, "Colonia Benítez", INTA Station, in the forest, 5-XII-1984, *Ferraro 3074* (CTES). *Libertad Department*, 1 Km. from Puerto Tirol, 17-VII-1994, *Vesconi 221* (CTES). ***FORMOSA PROVINCE***, *Formosa Department*, "Reserva Guaycolec", route n° 11, 28 Km. northwards from Formosa City, 15-II-1995, in a forest on saline soil, *Ferraro et al. 4657* (CTES). ***MISIONES PROVINCE***, *San Ignacio Department*, Pastoreo Chico, 275 m alt., 18-II-1956, on trunk and branches of indigenous trees, *leg. J. Montes 10084A* (Herb. *Osorio 5339*); Pastoreo Grande, 290 m alt., 23-III-1953, on trunk and branches of *Chrysophyllum grisebachii, leg. J. Montes 10055C (Herb. Osorio 5379*); Gisela, 270 m alt., 12-III-1953, on trunk of Moraceae, elevated and humid site, leg. J. Montes 29A *(Herb. Osorio 3396*). *Candelaria Department*, Loreto, 220 m alt., 15-III-1956, on bark of trees, dense forest, shady, somewhat humid, elevated site, *leg. J. Montes 10036E (Herb. Osorio 5401*); 6-V-1953, on trunks of trees, *leg. J. Montes 6 (Herb. Osorio 3377*). ***SALTA PROVINCE***, *Salta Department*, 20 Km. eastwards from Salta City, route from Salta to Gral. Güemes, 22-III-1979, on *Zyziphus* sp., *Schinini 1455* (CTES). ***TUCUMAN PROVINCE***, *Grassi 16217* (CTES); *Leales Department*, Puestos. *Digilio-Grassi 85* (LILL 2709); *Tucumán Department*, Marcos Paz, on fence post, 5-VIII-1947, *leg. M. E. Lamb* (LILL 9264). **BOLIVIA**, *Tarija Department*, Gran Chaco, Villa Monte, 2-IV-1977, *Krapovickas 33912* (CTES). **BRAZIL**, *Río Grande do Sul*, Porto Alegre, in Cereo aliisque Cactaceis arborescentibus, *G. A. Malme 456* (S). *Minas Gerais*, São João del Rey, *G. A. Malme 194* (S). **MEXICO**, *Baja California del Sur State*, 22 Km. WSW of Villa Constitución, desert community in ancient beach zone, 24° 57′ N, 111° 51' W, 18-III-1976, on *Fouqueria peninsularis*, *T. Nash III 12837* (CTES). **PARAGUAY**, *Presidente Hayes Department*, Military Harbour, in front of Concepción, 8-XI-1989, in disturbed forest, *Ferraro 3797* (CTES). *Misiones Department*, W of Yaciretá Island, 25-XI-1989, *Ferraro et al. 3576* (CTES). *Boquerón Department*, "Colonia Fernheim", Filadelfia, park "Reserva para la Salud Mental", 7-IX-1990, *Vanni et al. 2568* (CTES). ***R. asperula:*** **PERU**, Lima, *leg. Barranca*, (M; lectotype!). ***Ramalina complanata*** (as ***R. denticulata***): **BRAZIL**, Río de Janeiro, horto botanico Lich. Exped. Regnell. 1^{mae}, *G. Malme 371* (S); Boa Vista, Lich. Exped. Regnell. 1^{mae}, *G. Malme 115* (S); leg. Glaziou (M 1867, 1868). ***R. subfraxinea*** var. ***leiodea:*** **ECUADOR**: *Imbambura*, Quichinche, 8 km. W from Otavalo, 2500 m s.n.m, cultivated area, 17-VI-1983, *leg. L. & A. Arvidsson*, Flora of Ecuador (Lichenes) 3166, 3170 (TNS 492340 A, B). **AUSTRALIA**: *Toogom*, Harvey Bayshire, on *Callitris*, foreshore, 22-XI-85. *Forster 709*. (BRI 492340). *N. Keppel Island*, near North end, on *Pouteria sericea*, 29-IX-1987, *Evans* 5090 (BRI 492339). ***R. subfraxinea*** var. ***confirmata:*** **AUSTRALIA**: *Maroochydore*, "Yatch Club" Island, on branches of *Avicennia marina*, 22-VIII-1976, *Stevens 1335*, (BRI 492327).

DISCUSSION AND CONCLUSIONS

Most important characters for distinguishing the species studied here, ***Ramalina complanata***, ***R. asperula***, ***R. aspera*** and ***R. subfraxinea***, are the kind of thallus surface, pseudocyphellae, chondroid tissue and medullary substances (Table 1). Main distinctive features of ***R. aspera*** are the rugose-reticulate surface, the tuberculate pseudocyphellae, the non-cracked chondroid tissue, and the K- medulla producing either divaricatic acid or boninic acid or cryptochloropheic acid. The species is clearly distinguished from ***R. asperula*** and ***R. subfraxinea*** by the thallus surface and the pseudocyphellae. However, while ***R. aspera*** and ***R. subfraxinea*** exhibit a similar thallus anatomy (Fig. 2 A-D), ***R. asperula*** has a cracked chondroid tissue, like ***R. complanata*** (Fig. 2 E-F). Finally, ***R. aspera*** differs from ***R. complanata*** by the K- medulla, and the absence of veins on thallus surface and cracks in the chondroid tissue (Fig. 2 A-B, E-F).

Table 1. ***Ramalina complanata*** and related species.

	R. complanata	*R. asperula*	*R. aspera*	*R. subfraxinea*
Thallus surface	Veined	Smooth to + angular	Rugose-reticulate	Smooth to rugose
Pseudocyphellae	Tuberculate	Depressed, rarely ± convex	Tuberculate	Regularly depressed, sometimes tuberculate or shortly linear
Chondroid Tissue	Distinctly cracked	Distinctly cracked	Not cracked	Not cracked
Medullary Substances	Race 1: divaricatic & salacinic acids Race 2: salacinic Acid	Divaricatic	Race 1: divaricatic acid (South America) Race 2: cryptochlorophеic acid (Africa) Race 3: boninic acid (South America , Africa)	var. subfraxinea: sekikaic acid aggregate, ramalinolic, paludosic and divaricatic acids var. confirmata: cryptochloropheic acid aggregate, paludo-sic aicd var. leiodea: boninic acid, 4-0-metilpaludosic and dimethyl-cryptochloropheic acids, sekikaic acid aggregate var. norstictica: norstictic and connorstictic acids
Known Distribution	Jamaica (type locality) & Brazil (Uruguay?)	Peru (type locality) & East Africa	South & Central America, East Africa	Colombia (type locality) & Australia

R. aspera is known for Paraguay (type locality), Brazil (Kashiwadani & Kalb 1993) and East Africa (Krog & Swinscow 1975, 1976). In the present work, the taxon is reported for Argentina for the first time, being the only species of the group present in the country (see below). ***R. aspera*** is widely distributed in Argentina, including the Provinces of Buenos Aires, Entre Ríos, Córdoba, Corrientes, Misiones, Chaco, Formosa, Salta and Tucumán. Its known distribution area is also extended to Bolivia and Mexico. The boninic acid chemical race, previously known only for East Africa (Krog & Swinscow 1975), is first reported for South America.

The type material of ***R. complanata*** comes from Jamaica (Central America). Most of the Argentine specimens cited in the literature under this taxon have been revised here (Grassi 1950; Osorio 1968, 1969, 1970a, 1975, 1979, 1981, 1982, Osorio & D'Espósito 1979), and belong to ***R. aspera***. However, since the true ***R. complanata*** grows in Brazil (Kashiwadani & Kalb 1993) and Uruguay (Osorio 1970b, among others), the possibility of collecting the species in north-eastern Argentina is not completely rejected.

Concerning ***R. subfraxinea,*** it was described from Colombian material, and later was cited for Australia (Stevens 1987). Grassi (1950) reports the species for Tierra del Fuego, but this is considered a doubtful citation: ***R. subfraxinea*** is a tropical species and, most likely, the mentioned specimen has been misidentified (in PC; unfortunately not available at the time of preparing this paper). A specimen from Buenos Aires Province, which had been referred to that species (BAFC 35535), is very small and could not be analyzed by TLC. However, its morphology and medullary reaction agrees with that of ***R. aspera***. Hence, the presence of ***R. subfraxinea*** in Argentina is discarded.

Finally, ***R. asperula*** Krempelh. is known from Peru (type locality) and East Africa. The Argentine specimen cited by Grassi (1950) was referred to this taxon by Krempelhuber himself (1878). Nevertheless, we observed tuberculate pseudocyphellae, non-cracked chondroid tissue, and K- medulla containing boninic acid. Therefore, it belongs to ***R. aspera***, ***R. asperula*** being still unknown to Argentina.

ACKNOWLEDGEMENTS

We thank Dr. Kashiwadani and Dr. Osorio for critical comments, and the following herbaria for loan of material: BRI, CTES, H, LIL, LPS, Herb. Osorio, S, TNS and TUR. Funds were provided by the University of La Plata.

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MYCOTAXON

Volume LXXIV(1), pp. 153-159 January-March 2000

POLYPORES OF A NORTH CAROLINA PIEDMONT FOREST

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ABSTRACT

On September 6, 1996 winds from Hurricane Fran downed trees throughout the Piedmont region of North Carolina and thereby provided abundant substrate for the development of polypore fungi. Two forested tracts in Wake Co., NC, totaling 115 hectares, were surveyed for polypore fungi. A 100% sampling of these tracts was completed during the first year after the hurricane. Fifty-eight polypore species representing 37 genera in five families were recorded on 24 taxa of woody plants. Five of these fungi are reported for the first time in North Carolina. Fourteen of the host-fungus associations are new reports for the United States.

INTRODUCTION

On September 6, 1996, Hurricane Fran, a weakening Class 3 hurricane (Mayfield, 1996) passed through Wake County, NC. The eye of the hurricane grazed the western edge of Raleigh as it tracked northwest from its landfall the previous day near Wilmington, NC. Wind gusts reaching 175 kilometers per hour uprooted trees loosely anchored in soil already saturated from intense rainfall, broke trees and scattered branch debris. Many trees were extensively damaged by wind, tornadoes, down bursts and other falling trees.

Fungi are the dominant decay organisms found in woody substrates (Overholts, 1953; Gilbertson and Ryvarden, 1986; Eriksson *et al.*, 1990). Among fungi, the polypores account for 70% of the fungal species able to decay wood and are responsible for 90% of the wood-decay in forest ecosystems (Overholts, 1953; Gilbertson and Ryvarden, 1986). Wood-decay fungi are also important to foresters and landowners as potential causes of economic loss. They are also crucial components in ecosystem nutrient cycling processes.

Many researchers have surveyed the biodiversity of fungi in North Carolina ecosystems (e.g. Coker, 1946, 1948; Lowe and Gilbertson, 1961; Grand *et al.*, 1975; Jung, 1987). The fungal flora of the southern Appalachian region of North Carolina has been well documented and is recognized for its diversity (Nakasone, 1996). Work continues on developing a list of the fungi found in a barrier island maritime forest (Grand, unpublished data). Of wood-decay fungi in the Piedmont, however, only the larger stipitate polypores have been intensively studied (Coker, 1948). Additionally, as general biodiversity surveys increasingly include microorganisms (Rossman, 1994), methods enabling efficient sampling and identification of these microorganisms could be useful to future researchers.

The period following the hurricane represented an opportunity to observe the formation of a potentially robust community of wood-decay fungi. The objective of this research was to conduct a systematic, descriptive survey of and to identify the polypore fungi found on coarse woody debris in a Piedmont forest.

MATERIALS AND METHODS

Study site

This study was conducted in Wake County, NC (latitude 38° 52′ N; longitude 78° 47′ W) on two state-owned forests: Schenck Demonstration Forest managed by the Department of Forestry, North Carolina State University, and an adjacent tract of land owned by the North Carolina Department of Corrections. These sites were determined as typical of North Carolina Piedmont forests. Both tracts had a high availability of new woody debris of different species and sizes that resulted from Hurricane Fran, the remains of older debris, and a diversity of substrate species that are the result of long term management strategies at the stand level.

The 108-hectare tract of Schenck Forest is divided into 31 stands including loblolly pine (*Pinus taeda* L.) plantations, natural pine stands, hardwood demonstration plantations and oak-hickory forests maintained as natural areas. Many stands suffered windthrow due to the high winds and saturated soil conditions that occurred during Hurricane Fran. Damage assessments reported three hundred-thousand board feet (mbf) of downed timber, of which 175 mbf were removed through salvage cuts (Jervis, 1997). The additional parcel of 7 hectares owned by the NC Department of Corrections contains stands of oak, hickory and beech. Upland soils belong to the Cecil and Cecil-Appling series, and bottomland soils belong to the Congaree series (Cawthorne, 1970).

Temperatures during the 1997 survey ranged from an average monthly low in December of 4.9° C to an average monthly high in July of 26.4° C. Total precipitation during the year was 103.7 cm with August the driest month (2.6 cm) and April the wettest month (12 cm). Monthly rainfall was below average during 7 months of the year (NOAA, 1997-1998).

Methods

Twenty-seven of 31 stands at Schenck Forest and two stands on Department of Corrections land were included in the survey. Omitted stands were those less than 10 years-old that suffered very little damage during the hurricane. Each stand was sampled twice, once between February and June 1997 and again between September 1997 and January 1998. Additional collections were made on a periodic basis. A 100% survey of each stand was accomplished during the two sampling periods using a strip cruise method. Each strip was 20 meters wide, and adjacent strips had a common boundary. This sample design maximized the number and types of potential substrates investigated. During the survey, debris in each strip was located and polypore basidiocarps and, where possible, underlying decayed wood were collected for identification and tallied. An observation consisted of debris supporting one or more basidiocarps of a single species.

Where microscopic examination was required for identification, fungal tissue was mounted in 5% KOH solution or Melzer's reagent (Hawksworth *et al.*, 1995). Overholts (1953), Grand (1985), Farr *et al.* (1989), Gilbertson and Ryvarden (1986, 1987) and Jung (1987) were used for species identification and as authorities for host records and geographical location. Nomenclature and classification follows Gilbertson and Ryvarden (1986, 1987). Nomenclature for host species follows Radford *et al.* (1968). Identified specimens were dried in an herbarium dryer and labeled. Voucher collections are housed in the Mycological Herbarium, Department of Plant Pathology, North Carolina State University.

RESULTS

From over 750 observations, 58 species of polypore wood-decay fungi representing 37 genera in five of the twelve polypore families were identified from the study site. Twenty-four woody taxa were recorded as substrates for the fungi.

Five polypore species found at Schenck Forest are new records for the State of North Carolina: *Coriolopsis rigida* (Berk. et Mont.) Murrill; *Dichomitous squalens* (P. Karst.) D.A. Reid; *Spongipellis delectans* (Peck) Murrill; *S. spumeus* (J.C. Sowerby) Pat.; *Trametes conchifer* (Schwein.) Pil. New state records are also indicated with an asterisk in the species checklist. Fourteen of the substrate-fungus associations have not been reported previously; they are indicated with a double asterisk in the species checklist.

Trametes versicolor (L.) Pil., *Trichaptum biforme* (Fr. in Klotzch) Ryvarden, *Trichaptum abietinum* (J. Dicks.) Ryvarden, and *Irpex lacteus* (Fr.) Fr. were widespread throughout the sampling period. These species showed a low-level of substrate preference, only to phyllum, and occurred on both small and large diameter debris at a variety of decay stages. As decay progresses additional species may be added to this list of commonly-found polypores as fungi that are competitive on well-decayed wood or require more time to form basidiocarps become more predominant.

SPECIES CHECKLIST

1. **Abortiporus biennis** (Bull.) Singer
   Substrate: *Liriodendron tulipifera* L. (yellow-poplar) **; *Quercus* spp. (oak).
2. **Antrodia albida** (Fr.) Donk
   Substrate: *Carya glabra* var. *odorata* (red hickory); *Juniperus virginiana* L. (eastern redcedar).
3. **Antrodia heteromorpha** (Fr.) Donk
   Substrate: *Pinus taeda* (loblolly pine); *Quercus alba* L. (white oak).
4. **Antrodia serialis** (Fr.) Donk
   Substrate: Unidentified hardwood
5. **Antrodia sinuosa** (Fr.) P. Karst.
   Substrate: *Juniperus virginiana* (eastern redcedar); *Pinus taeda* (loblolly pine).
6. **Bjerkandera adusta** (Willd.) P. Karst.
   Substrate: *Carpinus caroliniana* Walter (musclewood); *Fagus grandifolia* Ehrh. (beech); *Liriodendron tulipifera* (yellow-poplar); *Quercus alba* (white oak).
7. **Bondarzewia berkeleyi** (Fr.) Bond. et Singer
   Substrate: *Quercus* sp. (red oak group)
8. **Cerrena unicolor** (Bull.) Murrill
   Substrate: *Liriodendron tulipifera* (yellow-poplar)
9. **Chaetoporellus latitans** (Bourdot et Galzin) Bond. et Singer
   Substrate: *Cornus florida* L. (flowering dogwood) **, *Pinus taeda* (loblolly pine).
10. **Climacocystis borealis** (Fr.) Kotl. et Pouzar
    Substrate: *Pinus taeda* (loblolly pine)
11. **Coltricia cinnamomea** (Pers.) Murrill
    Substrate: *Pinus taeda* (loblolly pine) **; *Juniperus virginiana* (eastern redcedar) **.
12. **Coltriciella dependens** (Berk. et M.A. Curt.) Murrill
    Substrate: *Pinus taeda* (loblolly pine).
13. **Coriolopsis rigida** (Berk. et Mont.) Murrill *
    Substrate: *Acer rubrum* L. (red maple) and *Quercus alba* (white oak).

14. **Daedaleopsis confragosa** (Bolt.) J. Schröt.
    Substrate: *Betula nigra* L. (river birch); *Cornus florida* (flowering dogwood); *Fagus grandifolia* (beech); *Liquidambar styraciflua* L. (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* Ehrhart. (black cherry); *Quercus alba* (white oak); *Quercus* spp. (red oak group); *Ulmus* sp. (elm)
15. **Dichomitus squalens** (P. Karst.) D.A. Reid *
    Substrate: *Pinus taeda* (loblolly pine).
16. **Fomitopsis spraguei** (Berk. et M. A. Curt.) Gilb. et Ryvarden
    Substrate: *Liquidambar styraciflua* (sweetgum).
17. **Ganoderma applanatum** (Pers.) Pat.
    Substrate: *Acer rubrum* (red maple).
18. **Ganoderma lucidum** (W. Curt.) P. Karst.
    Substrate: *Liquidambar styraciflua* (sweetgum).
19. **Globifomes graveolens** (Schwein.) Murrill
    Substrate: *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar).
20. **Gloeophyllum sepiarium** (Fr.) P. Karst.
    Substrate: *Pinus taeda* (loblolly pine); *Juniperus virginiana* (eastern redcedar)
21. **Gloeoporus dichrous** (Fr.) Bres.
    Substrate: *Acer rubrum* (red maple); *Carpinus caroliniana* (musclewood); *Cornus florida* (flowering dogwood); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Pinus taeda* (loblolly pine); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* spp. (red oak group); *Ulmus rubra* Muhl. (slippery elm).
22. **Grifola frondosa** (J. Dicks.) Gray
    Substrate: *Acer rubrum* (red maple).
23. **Hapalopilus nidulans** (Fr.) P. Karst.
    Substrate: *Liriodendron tulipifera* (yellow-poplar) **; *Quercus alba* (white oak); *Quercus* sp. (red oak group).
24. **Heterobasidion annosum** (Fr.) Bref.
    Substrate: *Pinus taeda* (loblolly pine); *Pinus echinata* Mill. (shortleaf pine).
25. **Inonotus ludovicianus** (Pat.) Murrill
    Substrate: *Liquidambar styraciflua* (sweetgum).
26. **Irpex lacteus** (Fr.) Fr.
    Substrate: *Acer rubrum* (red maple); *Cornus florida* (flowering dogwood); *Gleditsia triacanthos* L. (honey locust); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Paulownia tomentosa* (Thunberg) Steudel (princess tree) **; *Prunus serotina* (black cherry).
27. **Ischnoderma resinosum** (Fr.) P. Karst.
    Substrate: *Ulmus* sp. (elm).
28. **Laetiporous sulphureus** (Bull.) Murrill
    Substrate: *Quercus* sp. (oak).
29. **Lenzites betulina** (Fr.) Fr.
    Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Fagus grandifolia* (beech); *Liquidambar styraciflua* (sweetgum); *Lonicera japonica* Thunberg (honeysuckle) **; *Quercus alba* (white oak); *Quercus* sp. (red oak group).
30. **Meripilus giganteus** (Fr.) P. Karst.
    Substrate: *Fagus grandifolia* (beech).

31. **Nigroporus vinosus** (Berk.) Murrill
    Substrate: *Liquidambar styraciflua* (sweetgum); *Pinus taeda* (loblolly pine).
32. **Oligoporus caesius** (Schrad.) Gilb. et Ryvarden
    Substrate: *Pinus taeda* (loblolly pine).
33. **Oligoporus fragilis** (Fr.) Gilb. et Ryvarden
    Substrate: *Pinus taeda* (loblolly pine).
34. **Oligoporus stipticus** (Pers.) Gilb. et Ryvarden
    Substrate: *Pinus taeda* (loblolly pine).
35. **Perenniporia compacta** (Overh.) Ryvarden et Gilb.
    Substrate: *Liquidambar styraciflua* (sweetgum); *Quercus* sp. (red oak group).
36. **Phaeolus schweinitzii** (Fr.) Pat.
    Substrate: *Pinus taeda* (loblolly pine).
37. **Phellinus gilvus** (Schwein.) Pat.
    Substrate: *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Carya glabra* (Mill.) Sweet (pignut hickory); *Carya* spp. (hickory); *Cornus florida* (flowering dogwood) **; *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group).
38. **Phellinus pini** (Thore) A. Ames
    Substrate: *Pinus taeda* (loblolly pine); *Pinus echinata* (shortleaf pine).
39. **Polyporus alveolaris** (DC.) Bond. et Singer
    Substrate: *Carya* sp. (hickory); *Quercus alba* (white oak).
40. **Polyporus arcularius** (Batsch) Fr.
    Substrate: *Juniperus virginiana* (eastern redcedar); *Quercus alba* (white oak).
41. **Polyporus elegans** Bull.
    Substrate: *Cornus florida* (flowering dogwood) **; *Liriodendron tulipifera* (yellow-poplar) **.
42. **Porodisculus pendulus** (Schwein.) Murrill
    Substrate: *Liquidambar styraciflua* (sweetgum) **.
43. **Pycnoporus cinnabarinus** (Jacq.) P. Karst.
    Substrate: *Acer rubrum* (red maple); *Liriodendron tulipifera* (yellow-poplar).
44. **Schizopora paradoxa** (Fr.) Donk
    Substrate: *Quercus alba* (white oak).
45. **Skeletocutis nivea** (Jungh.) J. Keller
    Substrate: *Prunus serotina* (black cherry).
46. **Spongipellis delectans** (Peck) Murrill *
    Substrate: *Acer rubrum* (red maple).
47. **Spongipellis spumeus** (J. C. Sowerby) Pat. *
    Substrate: *Acer rubrum* (red maple).
48. **Trametes cervina** (Schwein.) Bres.
    Substrate: *Quercus* sp. (red oak group).
49. **Trametes conchifer** (Schwein.) Pil. *
    Substrate: *Ulmus alata* Michx. (winged elm); *Ulmus* sp. (elm).
50. **Trametes elegans** (Spreng.) Fr.
    Substrate: *Acer rubrum* (red maple); *Fagus grandifolia* (beech); *Liquidambar sytraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar) **; *Quercus alba* (white oak); *Quercus* sp. (red oak group).
51. **Trametes hirsuta** (Wulf.) Pil.
    Substrate: *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

52. **Trametes pubescens** (Schumach.) Pil.
    Substrate: *Liriodendron tulipifera* (yellow-poplar); *Quercus* sp. (red oak group).
53. **Trametes versicolor** (L.) Pil.
    Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Cercis canadensis* L. (redbud); *Cornus florida* (flowering dogwood); *Cupressus arizonica* Greene (arizona cypress); *Fagus grandifolia* (beech); *Fraxinus* sp. (ash); *Ligustrum sinense* Lour. (privet); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group).
54. **Trametes villosa** (Fr.) Kreisel
    Substrate: *Pinus taeda* (loblolly pine) **.
55. **Trichaptum abietinum** (J. Dicks.) Ryvarden
    Substrate: *Pinus echinata* (shortleaf pine); *Pinus taeda* (loblolly pine).
56. **Trichaptum biforme** (Fr. in Klotzsch) Ryvarden
    Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group); *Ulmus* sp. (elm); *Vitis* sp. (grape) **.
57. **Tyromyces chioneus** (Fr.) P. Karst.
    Substrate: *Liquidambar styraciflua* (sweetgum); *Pinus taeda* (lolbolly pine).
58. **Tyromyces fissilis** (Berk. et M.A. Curt.) Donk
    Substrate: Unidentified hardwood debris.

SUMMARY AND CONCLUSIONS

Fifty-eight species of polypore wood-decay fungi were observed on 24 taxa of woody plants in this study. Five of these fungal species are new reports from North Carolina; 14 are new host-fungus records. These new records indicate that there is a continuing need to intensively survey the fungal population of the Piedmont. Additionally, as decay progresses on debris downed during the hurricane, the wood-decay fungi represented in this study could give way to a different mix of wood-decay species.

Given the importance of the wood-decay process in soil formation, nutrient cycling and creation of animal habitat, further areas of research could include the investigation of how stand management practices influence microorganism populations, including wood-decay fungi. Schenck Forest, as a continguous tract containing stands with documented management differences in the Piedmont region, provides an ideal experimental site for such work.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the helpful reviews and comments of Drs. E. Setliff, C.Hodges, B. Goldfarb and R. Braham.

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MYCOTAXON

Volume LXXIV(1), pp.161-215 January-March 2000

TAXONOMICAL STUDIES ON USTILAGINALES. XX.

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ABSTRACT

The smut fungi of grass genera *Brachiaria*, *Capillipedium*, *Coelorachis*, *Eremochloa*, *Eriochloa*, *Eulalia*, *Eulaliopsis*, *Hackelochloa*, *Heteropogon*, *Lasiurus*, *Leptochloa*, *Oropetium*, *Rhytachne*, *Sehima*, *Trachypogon*, *Tricholaena*, *Triplopogon*, *Tripogon*, *Urochloa* nad *Yakirra* have been studied, as well as some other smut fungi from different parts of the world.

NEW SPECIES proposed: *Entyloma arctotis* K. Vánky (type on *Arctotis lawsoniana*, Australia); *Macalpinomyces simplex* K. Vánky (type on *Loudetia simplex*, Zimbabwe); *Sporisorium eriochloae* K. Vánky (type on *Eriochloa fatmensis*, Sudan); *S. fastigiatum* K. Vánky (type on *Andropogon fastigiatus*, Zimbabwe); *S. gayanum* K. & C. Vánky (type on *Andropogon gayanus*, Zimbabwe); *S. hwangense* K. & C. Vánky (type on *Sporobolus panicoides*, Zimbabwe); *S. monachnes* K. & C. Vánky (type on *Tricholaena monachne*, Zimbabwe); *S. ovariicolopsis* K. Vánky (type on *Andropogon gayanus*, Zimbabwe); *S. sehimicola* K. Vánky (type on *Sehima ischaemoides*, Zimbabwe); *S. trachypogonis-spicati* K. & C. Vánky (type on *Trachypogon spicatus*, Zimbabwe); *S. triplopogonis* K. Vánky (type on *Triplopogon ramosissimum*, India); *Tilletia sporoboli* K. Vánky (type on *Sporobolus festivus*, Zimbabwe); *Ustilago alcornii* K. Vánky (type on *Tripogon loliiformis*, Australia).

NEW COMBINATIONS proposed: *Sporisorium andropogonis-micranthi* (Y. Ling & T. L. Chen) K. Vánky, based on *Sorosporium andropogonis-micranthi* (type on *Andropogon micranthus*); *Sporisorium cordobense* (Speg.) K. Vánky, based on *Ustilago cordobensis* (type on "*Panicum jaboncillo*" = *Digitaria insularis*); *Sporisorium crypticum* (Cooke & Massee) K. Vánky & M. S. Patil, based on *Cintractia cryptica* (type on *Pollinia argentea*); *Sporisorium cryptum* (McAlpine) K. Vánky, based on *Ustilago crypta* (type on *Panicum bicolor*); *Sporisorium desertorum* (Thümen) K. Vánky, based on

Sorosporium desertorum (type on *Coelorachis hirsuta*); *Sporisorium eremochloae* (L. Ling) K. Vánky, based on *Sphacelotheca eremochloae* (type on *Eremochloa ciliaris*); *Sporisorium filiforme* (Henn.) K. Vánky, based on *Ustilago filiformis* (type on *Andropogon contortus*); *Sporisorium glutinosum* (Zundel) K. Vánky, based on *Sorosporium glutinosum* (type on *Heteropogon contortus*); *Sporisorium indicum* (H. & P. Sydow & Butler) K. Vánky, based on *Ustilago indica* (type on *Ischaemum angustifolium*); *Sporisorium nealii* (Ellis & Anderson) K. Vánky, based on *Ustilago nealii* Ellis & Anderson (type on *Heteropogon melanocarpus*); *Sporisorium pollinianum* (Zundel) K. Vánky & R. G. Shivas, based on *Sphacelotheca polliniana* (type on *Pollinia leptostachys*); *Sporisorium polycarpum* (H. Sydow) K. Vánky, based on *Sorosporium polycarpum* (lectotype on *Eremochloa muricata*); *Sporisorium rhytachnes* (H. Sydow) K. Vánky, based on *Sphacelotheca rhytachnes* (type on *Rhytachne triaristata*); *Sporisorium sehimae* (M. S. Patil) K. Vánky, based on *Sorosporium sehimae* (type on *Sehima nervosum*), and *Sporisorium sulcati* (M. S. Patil) K. Vánky, based on *Sorosporium sulcati* (type on *Sehima sulcatum*).

SYNONYMS: *Cintractia eremochloae* Langdon (type on *Eremochloa bimaculata*) is *Sporisorium polycarpum* (H. Sydow) K. Vánky (type on *Eremochloa muricata*); all, *Sorosporium catharticum* Maire (type on *Cenchrus catharticus*), *Sorosporium penniseti* Mundkur (type on *Pennisetum ciliare*) and *Ustilago penniseti* Rbh. var. *verruculosa* Massenot (type on *Pennisetum ciliare*) represent *Sporisorium penniseti* (Rbh.) Ershad (neotype on *Pennisetum orientale*); both *Sorosporium lasiuri* S. Ahmad (type on *Lasiurus hirsutus*) and *Sorosporium lasiuri* Zambettakis (invalid name and later homonym; on *Lasiurus hirsutus*) are *Sporisorium desertorum* (Thümen) K. Vánky (type on *Lasiurus hirsutus*); both *Sphacelotheca capillipedii* L. Ling (type on *Capillipedium parviflorum*) and *Sphacelotheca pakistanica* S. Ahmad (type on *Capillipedium parviflorum*) are *Sporisorium andropogonis-micranthi* (Y. Ling & T. L. Chen) K. Vánky (type on *Andropogon micranthus* = *Capillipedium parviflorum*); *Sphacelotheca heteropogonis-triticei* L. Ling (type on *Heteropogon triticeus*) is *Sporisorium andropogonis* (Opiz) K. Vánky (type on *Andropogon angustifolius*); *Tolyposporium andropogonis* Patel & N. B. Kulk. (type on *Andropogon triticeus* = *Heteropogon triticeus*) is *Sporisorium glutinosum* (Zundel) K. Vánky (type on *Heteropogon contortus*).

EXCLUDED SPECIES: *Ustilago globulifera* Sacc. & Trotter (type on *Loudetia hordeiformis*) is a *Ustilaginoidea* species (Fungi Imperfecti).

NEOTYPE is designated for *Ustilago penniseti* Rbh. (= *Sporisorium penniseti* (Rbh.) Ershad).

KEYS to the smut fungi of 1. *Tripogon*, *Leptochloa* and *Oropetium*, 2. *Eremochloa*, *Coelorachis*, *Rhytachne*, *Lasiurus* and *Hackelochloa*, 3. *Eriochloa*, 4. *Capillipedium*, 5. *Heteropogon*, 6. *Eulalia* and *Eulaliopsis*, 7. *Trachypogon*, and 8. *Tricholaena* are given.

THE SMUT FUNGI OF *TRIPOGON*, *LEPTOCHLOA* AND *OROPETIUM* (GRAMINEAE)

Tripogon Roem. & Schult., with c. 30 known species from the Old World tropics, and one species in tropical America, belongs to the subfamily Chloridoideae, tribe Eragrostideae, subtribe Eleusininae. The genus is closely related to *Leptochloa* P. Beauv., with 40 species throughout the tropics and warm temperate parts of America and Australia. Here belongs also *Oropetium* Trin., with 6 species in Africa and India (Clayton & Renvoize, 1986:209, 211).

On *Tripogon* two smut fungi have been described: *Macalpinomyces tripogonis* and *Tilletia savilei*. On *Leptochloa* four smut fungi are known: *Tilletia leptochloae*, *Ustilago heterogena*, *U. ornata*, and *U. thaxteri*. No smut fungi were known on *Oropetium* until recently when *M. tripogonis* was collected on two *Oropetium* species in India by Ms. A. R. Patil.

Between unidentified specimens in the Mycological Herbarium of Plant Pathology Branch, Department of Primary Industries, Indooroopilly, Queensland, Australia (BRIP), a smut fungus different from the above-mentioned species was found on the native grass *Tripogon loliiformis*, coll. Dr. John L. Alcorn. It is described as:

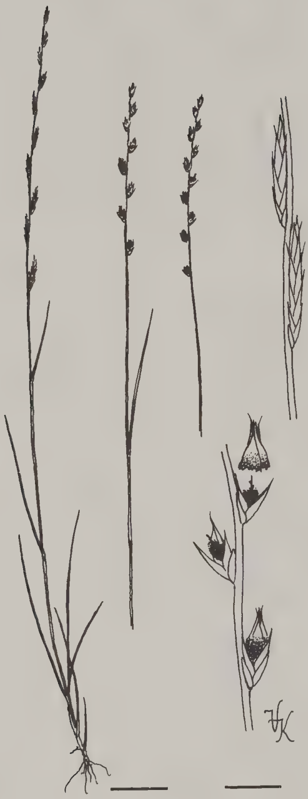
1. *Ustilago alcornii* K. Vánky, sp. nov.

Typus in matrice *Tripogon loliiformis* (F. Muell.) C. E. Hubb., Australia, Queensland, cca. 100 km N. Brisbane, Mt. Peregian (vel Mt. Emu), pr. Coolum Beach, 26°30' S, 153°06' E, alt. cca. 60 m.s.m., 27.III.1978, leg. J. L. Alcorn 7807. Holotypus in BRIP 12595!, isotypus in Herbario Ustil. Vánky, HUV 18660!

Sori inconspicui, spiculas destruentes, glumas et partem apicalem involucrorum floralium intactas relinquentes, cca. 1 x 1,5–2 mm, primo residuis involucrorum floralium cooperti, quibus maturitate una deciduis, massas nigras, pulvereas sporarum ostendentes, quarum dispersione axis spiculi columellae similis relictus. Peridium nullum, neque cellulae steriles, neque glomeruli sporarum presentes. *Sporae* forma satis variabiles, globosae, ovoideae, elongatae usque irregulares, 11–17 x 12–19(–21) µm, mediocriter usque atro-subrufo-brunneae; pariete aequali, 1–1,5 µm crasso, leniter, satis dense punctato-echinulato, lineam extremam sporae vix afficienti.

Sori (Fig. 1) inconspicuous, destroying the spikelets, leaving the glumes and the apical part of the floral envelopes intact, c. 1 x 1.5–2 mm, first covered by the remnants of floral envelopes which fall at maturity in one piece, disclosing the black, powdery masses of spores which are scattered leaving the columella-like axis of the spikelet behind. No peridium, no sterile cells, no spore balls present. *Spores* (Figs. 3, 4) rather variable, globose, ovoid, elongated to irregular, 11–17 x 12–19(–21) µm, medium to dark reddish-brown; wall even, 1–1.5 µm thick, finely, rather densely punctate-echinulate which just affects the spore profile.

On *Tripogon loliiformis* (F. Muell.) C. E. Hubb. Known only from the type collection.



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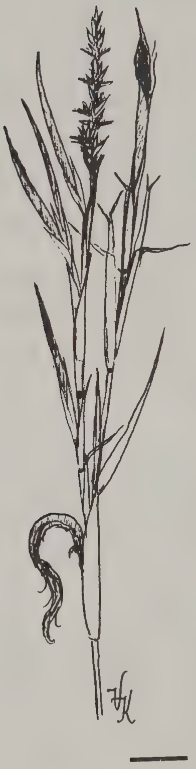

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Fig. 1. *Ustilago alcornii* K. Vánky on *Tripogon loliiformis* (F. Muell.) C. E. Hubb. To the left a healthy plant and two infected spikes. Enlarged two healthy and three infected spikelets (type). Bars = 1 cm (left) and 2 mm (right).

Fig. 2. Sori of *Sporisorium desertorum* (Thümen) K. Vánky in the inflorescences of *Lasiurus hirsutus* (Forssk.) Boiss. One raceme escaped infection. (Pakistan, Dhaccar, 20.XI.1976, S. Ahmad; HUV 8984). Bar = 1 cm.

A study of some *Macalpinomyces* collections on *Tripogon* and *Oropetium*, which both belong to the same subtribe Eleusininae, revealed that they represent the one species, *M. tripogonis*. Its revised description, synonymy and host plant range is:

2. ***Macalpinomyces tripogonis*** (M. S. Patil) K. Vánky, 1996:119.

Tolyposporium tripogonis M. S. Patil, 1992:182 (as "*tripogonae*") — Type on *Tripogon bromoides* Roem. & Schult., India, Maharashtra State, Kolhapur Distr., Panhala, 10.XI.1987, coll. S. R. Yadav, HCIO 30114, isotypes in Bot. Dept. Shivaji Univ., Kolhapur, India, and in HUV 17454!

Sporisorium tripogonis R. V. Gandhe, N. D. Sharma & K. Vánky, in Vánky, 1993:34. — Type on *Tripogon jacquemontii* Stapf, India, Madhya Pradesh, 25 km E.N.E. of Jabalpur, near the water reserve, alt. 500 m, 10.X.1992, coll. N. D. Sharma et al., HUV 15424!, isotypes in Vánky, Ust. exs. No. 857.

Sori in some ovaries of the inflorescence, inconspicuous, ellipsoidal or ovoid, often with a short, acute tip, 0.5–1 x 1.5–2.5 mm, hidden by the floral envelopes, dark olivaceous- or blackish-brown, first covered by a thin membrane composed of the pericarp and a layer of hyphae. This membrane ruptures irregularly at maturity, disclosing the semiagglutinated to granular-powdery mass of spores in which scattered groups of sterile cells are embedded. Spore mass dark reddish-brown, rather easily desintegrating into single spores or into irregular, variably large groups ("pseudo spore balls"), composed of tens to hundreds of spores. *Spores* rounded or elongated, subpolyhedrally or polyhedrally irregular, rarely subglobose, 8–11 x 8.5–13.5 µm, medium reddish-brown; wall evenly or unevenly thick, 0.5–1 µm wide, finely and densely verrucose-echinulate, spore profile smooth to finely serrulate, under SEM finely, densely echinulate. *Sterile cells* in smaller or larger, subglobose, ellipsoidal or irregular, rather persistent groups, 25–80 x 30–100 µm, subhyaline, composed of tens or hundreds of cells. Single sterile cells globose, ovoid, ellipsoidal or slightly irregular, sometimes with a flattened side, 4–8 x 5–10(–14) µm, subhyaline, content homogenous, wall thin (c. 0.5 µm), smooth. *Spore germination* results in septate basidia on which ovoid to long-ellipsoidal basidiospores are produced on sterigmata, laterally at the septa and terminally (comp. Gandhe, 1978:39, figs. 20, 21).

On *Oropetium thomaeum* (L. fil.) Trin., *O. roxburghianum* (Steud.) M. S. Philips, *Tripogon bromoides* Roem. & Schult., *T. capillatus* Jaub. & Spach, *T. jacquemontii* Stapf, and *T. trifidus* Munro, S. Asia (India).

Macalpinomyces tripogonis is rather close to *M. eragrostiellae* K. & C. Vánky, type on *Eragrostiella bifaria* (Vahl) Bor (also from the subtribe Eleusininae), India. However, there are small differences in the spore size, spore wall thickness, size of the balls of sterile cells, that of the sterile cells and their wall thickness. The main difference between these two species lies in the spore wall ornamentation, evident also in LM but especially in SEM. This in *M. tripogonis* is finely verrucose-echinulate, in *M. eragrostiellae* finely punctate-verruculose.

3. ***Tilletia savilei*** R. V. Gandhe & K. Vánky, in Vánky, 1993:34.
Type on *Tripogon jacquemontii* Stapf, India.

For description and illustration see Vánky, 1993:34-37.

On *Tripogon filiformis* Nees ex Steud., *T. jacquemontii* Stapf, S. Asia (India).

4. ***Tilletia leptochloae*** Thirumalachar & Pavgi, 1968(1969):253.
Type on *Leptochloa filiformis* Nees (= *L. panicea* (Retz.) Ohwi), India, Rajasthan, Ajmer, X.1955, P. N. Mathur 1259 (n. v.).

According to the original description, *sori* in the ovaries, few ovaries in the panicle attacked to form dirty green, minute, round bodies up to 1 mm in diameter, filled with black, dusty spore mass. *Spores* globose, subglobose, ovoid, 12.9–17.2 µm in diameter; wall medium thick, ornamented with short, blunt triangular processes. *Sterile cells* numerous, globose to subglobose, occasionally irregular, about the size of the spores, hyaline, thick-walled, smooth.

On *Leptochloa panicea* (Retz.) Ohwi (*L. filiformis* Nees), S. Asia (India).

5. ***Ustilago heterogena*** Hennings, 1904:155.
Type on *Leptochloa virgata* (L.) P. Beauv., Brazil, Bom Fim, Rio Juruá, X.1900, E. Ule 2675. Topotype: 1901, E. Ule. Isotopotypes in Ule, Mycoth. brasil. No. 3, HUV 3712!

Ustilago pustulata Tracy & Earle, 1895:175 (not *U. pustulata* (DC.) Winter, 1880). — *Ustilago togata* Liro, 1924:183. — Type on *Panicum proliferum* Lam. (= *P. dichotomiflorum* Michaux), USA, Mississippi, Starkville, X.1894, S. M. Tracy. Topotype: X.1895, S. M. Tracy. Isotopotypes in Ellis & Ev., N. Amer. fgi. No. 3339, HUV 9234!

Sori producing large, up to several cm long, nodular, irregular or elongated galls on the stems, leaves or in the inflorescence, or small, rounded bodies in single flowers, first covered by a smooth membrane which ruptures irregularly disclosing the dark brown, powdery spore mass. No columellae, no spore balls, no sterile cells present. *Spores* rather variable in shape and size, globose, ovoid, ellipsoidal, elongated or irregular, 7–11 x 8–15 µm, reddish-brown; wall even, c. 1 µm thick, finely, moderately densely to densely echinulate, spines up to 0.5 µm high, spore profile nearly smooth to finely serrulate.

On *Leptochloa filiformis* (Lam.) P. Beauv. (syn. *L. mucronata* Kunth), *L. scabra* Nees, *L. virgata* (L.) P. Beauv., *L. viscida* (Scribner) Beal, *Panicum dichotomiflorum* Michaux (syn. *P. proliferum* Lam.), *P. virgatum* L., N. & S. America (USA, Mexico, Brazil).

Fischer (1953:266) considered *Ustilago pustulata* Tracy & Earle (= *U. togata* Liro) to be a synonym of *U. heterogena*. This opinion is followed here, despite the fact that *Leptochloa* (subfamily Chloridoideae) and *Panicum* (subfamily Panicoideae) are not closely related, but the sorus and spore morphology produced on members of these two host genera are similar.

6. ***Ustilago ornata*** Tracy & Earle, 1895:175.

Type on *Leptochloa mucronata* Kunth (= *L. filiformis* (Lam.) P. Beauv.), USA, Mississippi, Starkville, 1.X.1894, S. M. Tracy. Isotypes in Ellis & Ev., N. Amer. fgi. No. 3340, HUV 9325!, and in Herb. USDA 5028, HUV 4257! Topotype: 27.VIII.1895, S. M. Tracy. Isotopotypes in Seymour & Earle, Econ. fgi. No. 542, HUV 7306!, and Reliquiae Seymourianae, HUV 9931!

Sori in ovaries, infecting only some of them in the inflorescence, ovoid, often with a short, acute tip, 0.7–1 x 1–1.8 mm, first covered by a thin layer of the pericarp which ruptures irregularly disclosing the dark brown, semi-powdery mass of spores, or the sori fall off the plant entirely. *Spores* rather variable in size, globose, ovoid, ellipsoidal, rarely elongated or irregular, 9–14.5 x 10–16 µm, yellowish-brown; wall even, c. 0.5 µm thick, prominently, moderately densely echinulate, spines up to 1.5 µm high, in SEM between the spines finely verrucose.

On *Leptochloa filiformis* (Lam.) P. Beauv. (*L. mucronata* Kunth), *L. uninervia* (Presl) Hitchc. & Chase (*L. imbricata* Turb.), N. America (USA).

7. ***Ustilago thaxteri*** Zundel, 1939:579.

Type on *Leptochloa uninervia* (Presl.) Hitchc. & Chase (det. A. Chase), Argentina, Buenos Aires, 29.IX.1905, R. Thaxter (host plant as *Panicularia magellanica*; FH 7899). Holotype in BPI 168169!

Sori destroying the inflorescence and extending down and surrounding the upper portions of the stem, 1–3 mm in width, 10 cm or more in length, at first partly hidden by leaf sheaths and covered by a greyish-silvery delicate membrane which flakes away revealing a semiagglutinated to powdery, olivaceous-brown spore mass. *Spores* globose, ovoid to ellipsoidal or slightly irregular, (7–)8–10.5 x 8–11(–12) µm, light olivaceous-brown; wall even, c. 0.5 µm thick, apparently smooth to very finely punctate, in SEM finely, moderately densely verrucose.

On *Leptochloa uninervia* (Presl.) Hitchc. & Chase, S. America (Argentina).

Key to the smut fungi of *Tripogon*, *Leptochloa* and *Oropetium*

1. Sori in the ovaries 4
– Sori elsewhere 2
2. Sori in the spikelets, 1.5–2 mm long .... *Ustilago alcornii*
– Sori elsewhere 3
3. Sori as nodular galls on stems, leaves, inflorescence or flowers. Spores finely echinulate, spines up to 0.5 µm high .... *Ustilago hetrogena*
– Sori destroying the inflorescence. Spores apparently smooth to finely punctate .... *Ustilago thaxteri*
4. Spores 20–28 µm long .... *Tilletia savilei*
– Spores smaller 5
5. Spores 13–17 µm long, with blunt, triangular processes ..... *Tilletia leptochloae*
– Spores smaller, otherwise ornamented 6
6. Spores 10–16 µm long, prominently echinulate .... *Ustilago ornata*
– Spores 8–13.5 µm long, finely punctate-echinulate. *Macalpinomyces tripogonis*

THE SMUT FUNGI OF *EREMOCHLOA*, *COELORACHIS*, *RHYTACHNE*, *LASIURUS* AND *HACKELOCHLOA* (GRAMINEAE)

These genera belong to the subfamily Panicoideae, tribe Andropogoneae, subtribe Rottboelliinae. *Eremochloa* Büse is a homogenous genus with 9 species. It is related to *Coelorachis* Brongn., with c. 21 species. *Rhytachne* Desv. is a genus of 12 species, very closely related to *Coelorachis*. The monospecific *Lasiurus* Boiss., is a xeromorphic genus, loosely related to *Coelorachis*. *Hackelochloa* Kuntze, has only two species (Clayton & Renvoize, 1986:364-365). Three smut fungi have been published on species of *Eremochloa*: 1. *Sorosporium polycarpum* H. Sydow on *E. muricata*, 2. *Cintractia eremochloae* Langdon on *E. bimaculata*, and 3. *Sphacelotheca eremochloae* L. Ling on *E. ciliaris*. These three names represent two species, both belonging to the genus *Sporisorium*. Only one smut fungus, *Sorosporium desertorum* Thümen, has been described on *Coelorachis*, *C. hirsuta* Brongn. Actually, this host plant is the type of the genus *Lasiurus*, and its smut belongs to the genus *Sporisorium*. On *Lasiurus hirsutus* also *Sorosporium lasiuri* S. Ahmad was described, and one year later, invalidly, *Sorosporium lasiuri* Zambettakis. These three names represent the same fungus. On *Rhytachne* two smut fungi have been described: 1. *Sphacelotheca rhytachnes* H. Sydow, which is a *Sporisorium*, and 2. *Tolyposporella rhytachnes* Viennot-Bourgin. On *Hackelochloa* only one smut fungus, ***Sporisorium erythraeense*** (H. & P. Sydow) K. Vánky, is known (for description see Vánky, 1991:163-164).

1. ***Sporisorium polycarpum*** (H. Sydow) K. Vánky, **comb. nov.**

Basionym: *Sorosporium polycarpum* H. Sydow, Ann. Mycol. 35:26, 1937. — Lectotype (designated by Zundel, 1953:70) on *Eremochloa muricata* Hackel, Australia, New South Wales, Warialda, IV.1931, J. Vickery 114. Syntype on *Eremochloa muricata* Hackel, Australia, New South Wales, Drake, I.1936, L. Fraser 199, DAR. Isosyntypes in BPI 180137!, 195128, and IMI 44436!

Cintractia eremochloae Langdon, 1948:3. — Type on *Eremochloa bimaculata* Hackel, Australia, Queensland, Brisbane, Moreton District, Virginia, 1.I.1941, leg. S. T. Blake, BRIP 8090!

Sori comprise the innermost floral organs of all sessile, fertile spikelets, ovoid to cylindrical, inconspicuous, 1 x 2–4 mm, partly hidden by the glumes, first covered by a thick, brown peridium of fungal and host origin which ruptures from its apex disclosing the dark brown, first agglutinated, later granular powdery mass of spore balls surrounding a simple central columella of the length of the sorus. On the top of young sori remnants of floral organs (anthers, stigma, and often also tips of lemma and palea) are visible. *Spore balls* globose, ellipsoidal, elongated or irregular, 50–150 μm long, semi-permanent, dark reddish-brown to opaque, composed of many (tens to several hundreds) spores. *Spores* globose, subglobose to broadly ellipsoidal, usually slightly subpolyhedrally irregular, 5.5–7 x 6.5–8(–9) μm, yellowish-brown; wall even, thin (c. 0.5 μm), smooth to finely punctate, spore profile smooth, in SEM finely, densely verrucose.

On *Eremochloa bimaculata* Hackel, and *E. muricata* Hackel, Australia.

2. ***Sporisorium eremochloae*** (L. Ling) K. Vánky, **comb. nov.**

Basionym: *Sphacelotheca eremochloae* L. Ling, Sydowia 4:77, 1950. — Type on *Eremochloa ciliaris* (L.) Merr., Indo-China [= North Vietnam], Tonkin Region, Thanh Hoa, Vien Giang, 24.II.1893*, R. P. Bon 9900, FH!

Sori in the spikelets, leaving intact the distal part of the outermost floral envelopes, 1–1.5 mm in length, or destroying the whole inflorescence, 4–6 mm in length, first covered by a thin peridium which ruptures disclosing the dark choclate-brown, pulverulent mass of spore balls and spores surrounding a central columella with short branches. *Spore balls* globose to ellipsoidal, 30–50 x 30–60 µm, dark reddish-brown, composed of c. 30–60? easily separating spores. *Spores* globose, ovoid to long-ellipsoidal, 6.5–9 x 7–11(–12) µm, reddish-brown; wall even, c. 1 µm thick, moderately densely, finely verrucose-echinulate, which does not, or just affects the spore profile.

On *Eremochloa ciliaris* (L.) Merr., S.-E. Asia (North Vietnam).

*Because of the unclear, hand-written label, the date of collection in the original description of *Sphacelotheca eremochloae* is erroneously given as "9.II.1893" instead of 24.II.1893.

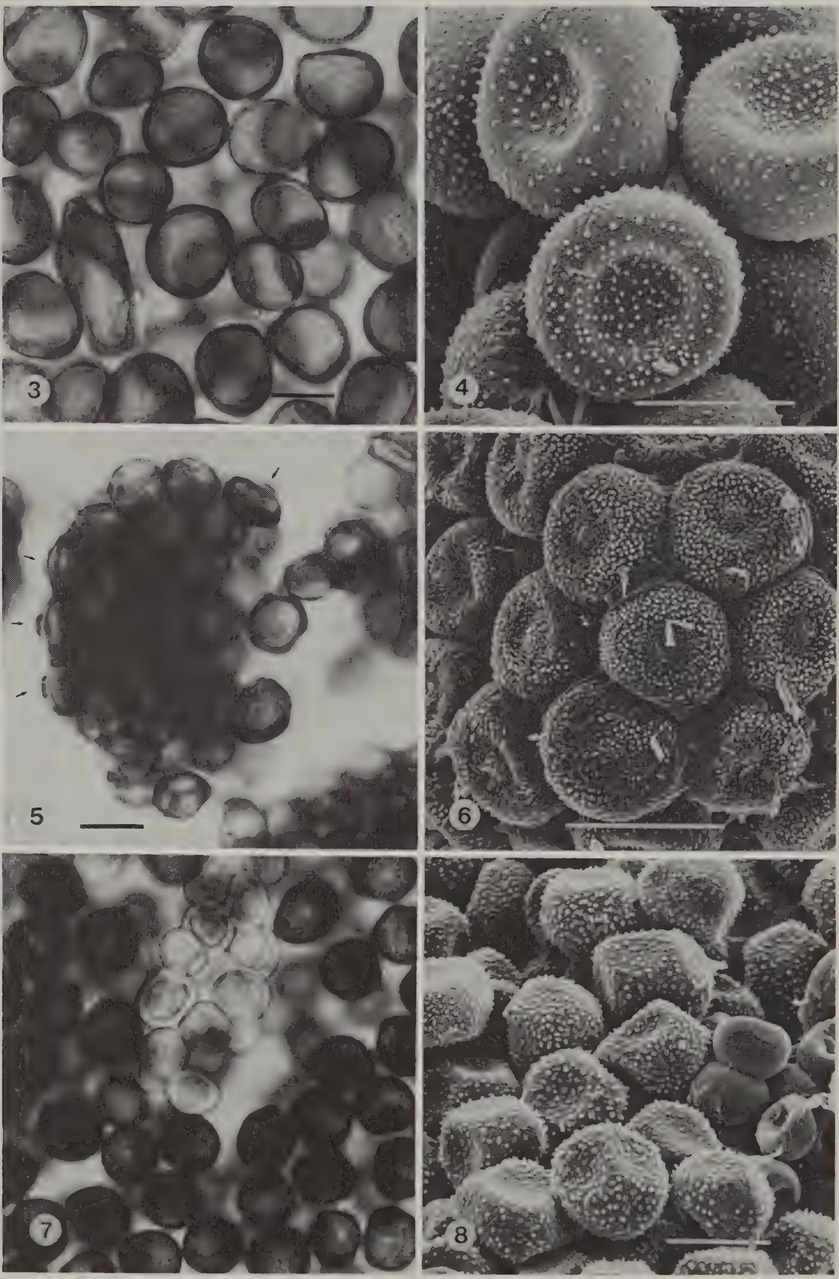
3. ***Sporisorium desertorum*** (Thümen) K. Vánky, **comb. nov.**

Basionym: *Sorosporium desertorum* Thümen, Grevillea 8:50, 1879. — Type on *Coelorachis hirsuta* (Forssk.) Brongn. (= *Lasiurus hirsutus* (Forssk.) Boiss.), "im Wadi Gundeli bei der Palastruine Dar el Beda, mittelaegyptische Wüste, arabische Seite" [in Wadi Gundeli, at the ruins of the palace Dar el Beda, Mid Egyptian Desert, Arabic side; today probably in Chad], 31.IV.1879, G. Schweinfurth, HUV 7254! (damaged by insects). Isotypes in Thümen, Mycoth. univ. No. 1514, HUV 1656!, and in Roumeg., Fgi. sel. gall. exs. No. 4724, HUV 12834!

Sorosporium lasiuri S. Ahmad, 1969:38. — Type on *Lasiurus hirsutus* (Forssk.) Boiss., Pakistan, Shahkot hills, 20.IV.1957, S. Ahmad 15330.

Sorosporium lasiuri Zambettakis, 1970:675, later homonym and invalid name (ICBN, Art. 36.1 & 37.1). — On *Lasiurus hirsutus* (Forssk.) Boiss., Mauritania, at Taziast (without date and name of collector).

Sori (Fig. 2) destroying the whole inflorescence (raceme), more rarely only a part of it or only a few spikelets in the raceme, fusiform, 1–2(–3) x 10–35 mm, partly hidden by leaf sheaths, covered by a thick, brown peridium which ruptures irregularly disclosing the dark brown mass of spore balls, spores, sterile cells and several long, filiform columellae. All racemes or only some of them in a plant may be affected. *Spore balls* globose to irregularly ellipsoidal, 35–60(–75) µm long, dark reddish-brown, easily separating into single spores. *Spores* globose, subglobose, ellipsoidal, slightly irregular, 8.5–10.5 x 9.5–12(–13) µm, reddish-brown; wall uneven, 1–1.5 µm wide, thickest at the angles; inner spores finely punctate, outer spores coarsely verrucose-echinulate, especially on their free surface. *Sterile cells* single, globose, subglobose, ellipsoidal, usually more or less flattened, 8–16 µm long, hyaline; wall 1–1.5 µm thick, smooth.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On *Lasiurus hirsutus* (Forssk.) Boiss. (*Coelorachis hirsuta* (Forssk.) Brongn.; *Rottboellia hirsuta* (Forssk.) Vahl, *Lasiurus sindicus* Henr.), N. Africa (Chad, Mauritius) and S. Asia (India, Pakistan).

According to the original description, the sori of *Sorosporium desertorum* are in the ovaries. Study of the rich type collection and other specimens resulted in the description given above. The original description mislead Ahmad, who collected smutted *Lasiurus hirsutus* in which the whole inflorescence were destroyed. He also found that the spores are somewhat larger than given in the description of *S. desertorum*. Consequently, he described the fungus as a new species, *Sorosporium lasiuri* S. Ahmad. I did not see the type specimen of *S. lasiuri*, and I do not know where it is preserved. However, I got a rich collection of *S. lasiuri* on *Lasiurus hirsutus* from Sultan Ahmad, collected by him in Pakistan, near Dakkar, on 20.XI.1976, HUV 8984! I compared this specimen with the type of *S. desertorum* and found them to be identical. Hence the established synonymy.

Ustilago vilfae Winter on *Lasiurus sindicus* Henr. (= *L. hirsutus* (Forssk.) Boiss.), reported by Agarwal et al. (1977) from India, Rajastan, Jodhpur, Jaisalmer, 4.IX.1976, L. D. Ahuja, HCIO 32094! is *Sporisorium desertorum*.

4. ***Sporisorium rhytachnes*** (H. Sydow) K. Vánky, **comb. nov.**

Basionym: *Sphacelotheca rhytachnes* H. Sydow, Ann. Mycol. 37:201, 1939. — Type on *Rhytachne triaristata* Stapf, Sierra Leone, Mama Beach near Kent, roadside, 3.XII.1936, F. C. Deighton 1109, IMI 4305!

Sori destroying the inflorescence (raceme), long linear, up to 2.5 mm wide and 1–6 cm long, at first enclosed in the leaf sheath and covered by a dark brown peridium which dehisces revealing the black, powdery mass of spore balls and spores, surrounding a long, filiform columella. All inflorescences of a plant are affected. *Spore balls* globose to ellipsoidal or slightly irregular, 30–60 µm long, dark reddish-brown, composed of 15–50? easily separating spores. *Spores* moderately subpolyhedrally irregular, more rarely globose or broadly ellipsoidal, 10–14 x 11–15(–16) µm; outer spores dark reddish-brown, wall c. 1.5 µm thick, prominently verrucose-echinulate, giving the spore profile a serrulate aspect; inner spores light yellowish-brown, usually smaller and more irregular than the

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Figs. 3, 4. Spores of *Ustilago alcornii* K. Vánky on *Tripogon loliiformis* (F. Muell.) C. E. Hubb., in LM and in SEM (type). Bars = 10 µm.

Figs. 5, 6. Spore balls and spores of *Sporisorium eriochloae* K. Vánky on *Eriochloa fatmensis* (Hochst. & Steud.) W. D. Clayton, in LM and in SEM. Note the thickened areas of the external spores in the LM picture (arrows) which appear as small mamillae in SEM picture (type). Bars = 10 µm.

Figs. 7, 8. Spores and sterile cells of *Sporisorium sehimicola* K. Vánky on *Sehima ischaemoides* Forssk., in LM and in SEM (type). In LM picture, the small remnants of sporogenous hyphae appear as light dots. Bars = 10 µm.

outer ones, wall c. 0.5 µm thick, finely, densely verrucose which just affects the spore profile.

On *Rhytachne triaristata* Stapf, W. Africa (Sierra Leone).

5. ***Tolyposporella rhytachnes*** Viennot-Bourgin, 1958:167.

Type on *Rhytachne minor* Pilger, Guinea, near Kindia, Foulaya, I.1957, G. Viennot-Bourgin. Holotype in PC, isotype in HUV 15804!

Sori on the adaxial side of the rolled, tube-like leaves, forming 1–6 cm long, subepidermal striae which rupture filling the leaf-tubes with black spore masses agglutinated in irregular groups of 2–8 or more spores. *Spores* variable in shape and size, usually subpolyhedrally irregular, with one or several flattened sides or elongated into a rostrum, more rarely globose or ovoid, 9–20 x 9–25 µm, subglobose spores may measure 9–18 µm in diameter, pale olivaceous- to dark reddish-brown; wall uneven, thick, multilayered, 2–8 µm wide, smooth.

On *Rhytachne minor* Pilger, W. Africa (Guinea). Known only from the type collection.

The generic position of *Tolyposporella rhytachnes* is uncertain. A revision of the c. 10 *Tolyposporella* species is badly needed. Recently, Walker & Shivas (1998) placed *T. brunkii* into the genus *Jamesdicksonia* as *J. brunkii* (Ellis & Galloway) J. Walker & R. G. Shivas (type on *Andropogon argenteus* Ell., USA).

Key to the smut fungi of *Eremochloa*, *Coelorachis*, *Rhytachne*, *Lasiurus* and *Hackelochloa* (*S.* = *Sporisorium*).

1. Sori on the leaves, no peridium, no columella. Spore wall 2–8 µm wide, multilayered. On *Rhytachne*.................................. *Tolyposporella rhytachnes*
– Sori not on the leaves, peridium and columella present. Spore wall less than 2 µm wide, not multilayered 2
2. Sori usually restricted to the flowers or spikelets. On *Eremochloa*..................6
– Sori usually destroying the whole inflorescence. Not on *Eremochloa*..............3
3. Columella one 4
– Columellae several, filiform. On *Lasiurus* ....*S. desertorum*
4. Columella branched. Spores 9.5–12 µm long, wall c. 0.8 µm thick, minutely echinulate. On *Hackelochloa* ....*S. erythraeense*
– Columella simple. Spores larger. Not on *Hackelochloa* 5
5. Spores 11–15(–16) µm long, dimorphic. Sterile cells absent. On *Rhytachne* ....*S. rhytachnes*
– Spores 11–13.5 µm long, all similar. Sterile cells present. On *Coelorachis* ....*S. coelorachidis* (unpublished)
6. Sori in the flowers. Columella simple. Spores 6.5–8(–9) µm long, wall c. 0.5 µm thick, smooth to finely punctate..........................*S. polycarpum*
– Sori in the spikelets (more rarely in the whole inflorescence). Columella with short branches. Spores 7–11(–12) µm long, wall c. 1 µm thick, verrucose-echinulate...................................*S. eremochloae*

THE SMUT FUNGI OF *BRACHIARIA*, *ERIOCHLOA*, *UROCHLOA* AND *YAKIRRA* (GRAMINEAE)

Brachiaria (Trin.) Griseb., *Eriochloa* Kunth, *Urochloa* P. Beauv., and *Yakirra* Lazarides & R. D. Webster belong to the subfamily Panicoideae, tribe Paniceae, subtribe Setariinae (Clayton & Renvoize, 1986).

I revised (Vánky, 1997b:138-141) the smut fungi of *Brachiaria* and recognised six species. A further smut fungus, desribed on *Panicum*, *Sorosporium cryptum* (McAlp.) McAlp., which belongs to the genus *Sporisorium*, was also found on *Brachiaria* and *Yakirra*. On *Yakirra*, with six species in Australia and Burma, no other smut fungi have been reported.

Sporisorium cryptum (McAlp.) K. Vánky, **comb. nov.**

Basionym: *Ustilago crypta* McAlpine, Proc. Linn. Soc. New South Wales 32:42, 1897. — *Sorosporium cryptum* (McAlp.) McAlpine, 1910:176. — Type on *Panicum bicolor* R. Br. (= *P. bicoloratum* S. T. Blake), Australia, New South Wales, 1896, Maiden, VPRI 2956.

Sori in the spikelets infecting all in the inflorescence, leaving intact the outermost floral envelopes, ovoid to cylindrical, 0.5–1.5 x 1–15 mm (depending on the host species), first covered by a pale brown peridium which ruptures from its apex disclosing the dark brown, semiagglutinated to powdery mass of spore balls and spores surrounding a stout, simple, tapering columella. *Spore balls* variable in shape and size, globose, ellipsoidal, elongated or irregular, 30–100 x 40–160 µm, dark brown to opaque, composed of tens to hundreds of easily separating spores. *Spores* subglobose, subpolyhedrally irregular, mostly ellipsoidal, 6–9.5 x 8–10.5 µm, yellowish-brown; wall even, c. 0.8 µm, finely punctate to verruculose, spore profile smooth, in SEM finely verrucose-echinulate, the spores often appearing mamillate. *Sterile cells* not seen.

On *Brachiaria holosericea* (R. Br.) Hughes, *B. polyphylla* (R. Br.) Hughes, *Panicum bicoloratum* S. T. Blake (*P. bicolor* R. Br.), *P. effusum* R. Br., and its var. *simile* (Domin) B. K. Simon (*P. simile* Domin, *P. fulgidum* Hughes), *P. queenslandicum* Domin, *Yakirra pauciflora* (R. Br.) Lazarides & R. D. Webster (*Panicum pauciflorum* R. Br.), Australia.

Sporisorium cryptum differs from the rather similar *S. serratum* (L. Ling) K. Vánky (type on *Brachiaria serrata* Stapf, Malawi) in the size, colour, wall thickness and ornamentation of the spores. Spores of *S. serratum* measure 6.5–9 µm in length, are darker, possessing a slightly unevenly thicker wall (0.5–1.5 µm), and are apparently smooth to finely punctate-verruculose.

Eriochloa, with 30 species in the tropics, is distinguished by a little "bead" at the base of each spikelet. Several smut fungi have been reported on species of *Eriochloa*. Of these, *Sorosporium eriochloae* Griffiths (type on *E. punctata* (L.) Desv., USA) is **_Sporisorium mixtum_** (Massee) K. Vánky (for description, type and synonyms see Vánky, 1995b:214). **_Ustilago eriochloae_** L. Ling (type on "*E.*

punctata" = misidentified *Paspalum* sp.; Piepenbring, 1996:134) represents *Ustilago schroeteriana* Henn. (type on *Paspalum* sp., Brasilia). Further studies revealed two additional smut fungi on *Eriochloa*: a *Tilletia* and a *Sporisorium* species.

Study of smutted *Eriochloa procera* (Retz.) C. E. Hubb., collected in India, Uttar Pradesh, 25 km NE Delhi, 28.IX.1992, T. & K. Vánky, HUV 15973, showed that the smut is identical with ***Tilletia brachiariae*** (Pavgi & Thirum.) K. Vánky (based on *Tilletia pulcherrima* Ellis & Galloway ex G. P. Clinton var. *brachiariae* Pavgi & Thirumalachar, type on *Brachiaria distachya* Stapf, India). For description see Vánky, 1997b:140. The occurrence of the same smut fungus on members of *Brachiaria* and *Eriochloa* is also an evidence for the close relationship between these two genera; *Eriochloa* is considered to be derived from *Brachiaria* (Clayton & Renvoize, 1986:269, fig. 19).

Study of smutted *Eriochloa nubica* (Steud.) Hack. & Stapf ex Thell., collected in Sudan and preserved in several herbaria under the name of *Tolyposporium* sp., revealed that it is a different, still undescribed smut fungus.

Sporisorium eriochloae K. Vánky, **sp. nov.**

Typus in matrice *Eriochloa fatmensis* (Hochst. & Steud.) W. D. Clayton (*E. nubica* (Steud.) Hack. & Stapf ex Thell.), Sudan, Malakal, 9°31' N, 31°40' E, 12.X.1956, S. A. J. Tarr. Holotypus in Herbario Ustil. Vánky, HUV 17807!, isotypi in BPI 192688, IMI 67783 et in Sudan Mycological Herbarium No. 2877.

Sori in ovariis, cylindrici, cca. 1 x 5–10 mm, peridio crasso, pallide flavido-brunneo cooperti, quo in fascias nonnullas ab apice rupto, massam glomerulorum sporarum nigram, granulari-pulveream, columellam tenuem, rigidam, centralem longitudine soro aequalem circumdantem ostendentes. *Glomeruli sporarum* subglobosi, late ellipsoidales, elongati vel irregulares, 30–60(–70) x 40–80(–100) µm, atro-subrufobrunnei, semipermanentes, e pluries decem sporarum pressione separabilium compositi. *Sporae* subglobosae, ellipsoidales usque subpolyedriter irregulares, 8–11 x 9,5–13 µm; sporae internae pallide flavido-brunneae, conspicue leves usque leniter et dense punctatae; pariete tenui (cca. 0,5 µm), paene aequali; sporae externae subrufobrunneae, leniter, dense, uniformiter verrucosae; pariete inaequali, 0,5–1,5(–2) µm, maxime crasso ad angulos et typice in medio superficiei sporarum maxime externarum. Partes hae sporarum arefactarum sub SEM sicut areae parvae mamilliferae apparentes. *Cellulae steriles* non observatae.

Sori (Fig. 9) in the ovaries, cylindrical, c. 1 x 5–10 mm, covered by a thick, pale yellowish-brown peridium which ruptures into several bands from its apex, disclosing the black, granular-powdery mass of spore balls surrounding a thin, stiff, central columella of the length of the sorus. *Spore balls* (Figs. 5, 6) subglobose, broadly ellipsoidal, elongated or irregular, 30–60(–70) x 40–80(–100) µm, dark reddish-brown, semi-permanent, composed of tens of spores separating by pressure. *Spores* (Figs. 5, 6) subglobose, ellipsoidal to subpolyhedrally irregular, 8–11 x 9.5–13 µm; inner spores pale yellowish-brown, apparently smooth to finely and densely punctate, wall thin (c. 0.5 µm), nearly even; outer spores reddish-brown, finely, densely, uniformly verrucose, wall unevenly thick, 0.5–1.5(–2) µm, thickest at the angles and typically in the middle of the free surface of the outermost spores. These parts, in dried spores, under SEM, appear as small mamillae. *Sterile cells* not seen.

On *Eriochloa fatmensis* (Hochst. & Steud.) W. D. Clayton (*E. nubica* (Steud.) Hack. & Stapf ex Thell.), Africa (Sudan).

The appearance of mamillate areas of dried spores (seen in SEM) is a consequence of a certain spore wall structure. Mamillae appear when a restricted, rounded, thickened spore wall area is surrounded by a ring-shaped, or larger, thin-walled area. In dried spores, the thin-walled area sinks in, whereas the rounded, thick-walled middle portion protrudes as a mamilla. This phenomenon, evident also in *Anthracoidea uleana* (H. & P. Sydow) K. Vánky (*A. pannucea* (Liro) K. Vánky), was studied in detail. *A. uleana* has single spores around the nuts of various *Carex* species. Each spore has (2–)3–4(–5) such areas with a mamilla (comp. Vánky, 1987:17, fig. E).

Key to the smut fungi of *Eriochloa*.

1. Columella absent. Spores single, 19–24(–26) µm long........ *Tilletia brachiariae*
– Columella present. Spores in balls, smaller..2
2. Spores 9.5–15 µm long; wall evenly thick (c. 0.8 µm), finely verrucose-echinulate.. *Sporisorium mixtum*
– Spores 9.5–13 µm long; wall unevenly thick (0.5–1.5(–2) µm), finely verrucose... *Sporisorium eriochloae*

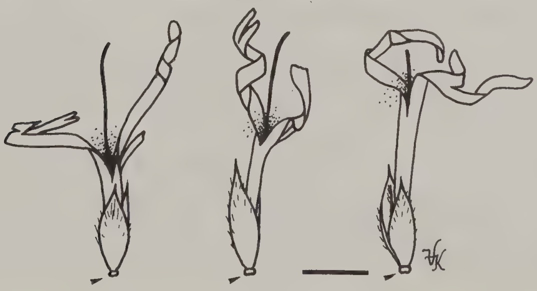

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Fig. 9. Sori of *Sporisorium eriochloae* K. Vánky in the ovaries of *Eriochloa fatmensis* (Hochst. & Steud.) W. D. Clayton (type). Note the little "bead" at the base of the spikelets (arrow heads), typical for *Eriochloa*. Bar = 2 mm

THE SMUT FUNGI OF *CAPILLIPEDIUM* (GRAMINEAE)

Capillipedium Stapf, a homogenous genus with c. 14 species in Eastern Africa, tropical Asia and Australia, belongs to the subfamily Panicoideae, tribe Andropogoneae, subtribe Sorghinae (Clayton and Renvoize, 1986:343). Four smut fungi are recognised on *Capillipedium*. These are:

1. ***Sporisorium andropogonis-micranthi*** (Y. Ling & T. L. Chen) K. Vánky, **comb. nov.**

Basionym: *Sorosporium andropogonis-micranthi* Y. Ling & T. L. Chen, Res. Bull. Inst. Zool. Bot. Fukien Acad. 1:21, ?first half of 1945. — Syntypes on *Andropogon micranthus* Kunth (= *Capillipedium parviflorum* (R. Br.) Stapf), China, Fukien Prov., Yungan, Moping, 26.IX.1942, T. L. Chen 294, and Fukien Prov., vicinity of Sha-hsien, 15.X.1942, T. L. Chen 300 (n. v.).

Sphacelotheca capillipedii L. Ling, September 12, 1945:8. — *Sporisorium capillipedii* (L. Ling) L. Guo, 1990:78. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, China, Szechwan Prov., Chengtu, 11.XI.1938, L. Ling, IMI 498!. Topotypes: 5.IX.1939, L. Ling, BPI 177299!, 5.II.1940, L. Ling, BPI 195086!, XI.1947, K. R. Lin, BPI 177298!

Sphacelotheca pakistanica S. Ahmad, 1956:7. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, Pakistan, Murree, VIII.1952, S. Ahmad. Isotype in HUV 7245!

Sori destroying the whole inflorescence or only branches of the panicle, often restricted to the racemes, cylindrical, usually with short lateral branches, 1–4 mm x 1–7 cm, first concealed by the terminal leaf sheath, later protruding, covered by a brown peridium which ruptures irregularly disclosing the dark brown, powdery mass of loose spore balls, spores and sterile cells surrounding a simple columella often with short branches. *Spore balls* when young subglobose, ellipsoidal, 80–100 µm in diameter, dark brown, composed of 50–200? spores surrounded by a hyaline coat of hyphae which gelatinises and disappears by maturity. *Spores* globose, subglobose to ellipsoidal, 7–10 x 8–11.5 µm, yellowish-brown; wall even, c. 0.5 µm thick, finely verruculose, spore profile smooth, in SEM between short spines densely verruculose. *Sterile cells* in irregular groups or in chains, single cells irregular, with one or several flattened sides, rarely globose, 5–10 x 6–11 µm, hyaline; wall thin (c. 0.5 µm), smooth.

On *Capillipedium parviflorum* (R. Br.) Stapf, *C. spicigerum* (Benth.) S. T. Blake (*Bothriochloa spicigera* (Benth.) T. Koyama), S. & E. Asia, Australia.

This is the smut fungus known as *Sporisorium capillipedii* (L. Ling) L. Guo, based on *Sphacelotheca capillipedii*. The description of this species appeared on September 12, 1945. The same species was described a few months earlier by Y. Ling & T. L. Chen. The exact date of the publication of vol. 1 of the Res. Bull. Inst. Zool. Bot. Fukien Acad. could not be established but most probably is prior to September 12, 1945, hence the new combination above.

2. ***Sporisorium taianum*** (H. Sydow) L. Guo, 1990:85.
Ustilago taiana H. Sydow, 1929:421. — *Sphacelotheca taiana* (H. Sydow) L. Ling, 1945:9. — *Sorosporium taianum* (H. Sydow) Zundel, 1953:75. — Type on *Andropogon micranthus* Kunth (= *Capillipedium parviflorum* (R. Br.) Stapf), China, Kiangsu (Jiangsu) Prov., Nanking, 12.IX.1928, F. L. Tai 2190. Holotype in HMAS 10693, isotypes in BPI 188947, 188948, HUV 12006! and IMI 503.

Sori in the ovaries, c. 1 x 3–4 mm, first covered by a delicate grayish peridium which flakes away disclosing the brown, powdery mass of spores and sterile cells surrounding a simple, 1–2 mm long central columella. *Spores* when mature single, globose, subglobose, ovoid, usually ellipsoidal with a more or less flattened side (where the spore wall is thinner), 5.5–7 x 6.5–8 µm, light olivaceous-brown; wall smooth, 0.5–0.8 µm thick, thinner on one side, where the spore colour is somewhat paler. *Sterile cells* in shorter or longer chains, flattened, rarely single, globose, 7–11 µm wide, hyaline, thin-walled (c. 0.5 µm), smooth.

On *Capillipedium parviflorum* (R. Br.) Stapf, E. Asia (China).

3. ***Macalpinomyces chrysopogonis*** (S. Ahmad) K. Vánky, 1997a:129.
Ustilago chrysopogonis S. Ahmad, 1956:2. — Type on *Chrysopogon gryllus* (L.) Trin., Pakistan, Swat State, Kulai-Kalam, 19.VIII.1953, S. Ahmad 4627. Isotype in HUV 8999!

Sorosporium capillipedii J. N. Mishra, 1957:257. — *Endosporisorium capillipedii* (Mishra) K. Vánky, 1995a:228. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, India, Bihar, Hazaribagh, 10.X.1955, J. N. Mishra. Isotypes in BPI 179479, HUV 16067! and IMI 68184.

For description see Vánky, 1995a:228 (as *Endosporisorium capillipedii*).

On *Capillipedium parviflorum* (R. Br.) Stapf, *Chrysopogon gryllus* (L.) Trin., *Ch. echinulatus* (Nees) W. Wats, *Ch. fulvus* (Spreng.) Chiov., S. Asia (Pakistan, India).

4. ***Sporisorium mysorense*** (Pavgi & Thirumalachar) K. Vánky, 1995a:230.
Sphacelotheca mysorensis Pavgi & Thirum., in Thirumalachar & Pavgi, 1952:394. — Type on *Capillipedium huegelii* (Hackel) A. Camus, India, Mysore, Shimoga Distr., at Bedur, V.1951, B. T. Lingappa. Holotype in HCIO 20130!

For description see Vánky, 1995a:230.

On *Capillipedium huegelii* (Hackel) A. Camus, S. Asia (India).

Key to the smut fungi of *Capillipedium*.

1. Sori in the interior of the stems .... *Macalpinomyces chrysopogonis*
– Sori not so 2
2. Sori usually comprise the whole inflorescence or only the racemes .... *Sporisorium andropogonis-micranthi*
– Sori restricted to the ovaries 3
3. Spores 10.5–13.5 µm long; wall very finely and densely punctate, with 4–6 thin, light areas .... *Sporisorium mysorense*
– Spores 6.5–8 µm long; wall smooth, thinner and lighter on one half.. *Sporisorium taianum*

THE SMUT FUNGI OF *HETEROPOGON* (GRAMINEAE)

The genus *Heteropogon* Pers., with six species throughout the tropics and subtropics, belongs to the subfamily Panicoideae, tribe Andropogoneae, subtribe Anthistiriinae (Clayton & Renvoize, 1986:359). On *Heteropogon* several smut fungi have been described. Of these, *Sphacelotheca heteropogonis-triticei* L. Ling was found to be identical with *Sporisorium andropogonis* (Opiz) K. Vánky, and *Tolyposporium andropogonis* Patel & N. B. Kulk. identical with *Sporisorium glutinosum* (Zundel) K. Vánky. The following eight smut fungi, all belonging to the genus *Sporisorium*, could be recognised on *Heteropogon*.

1. *Sporisorium andropogonis* (Opiz) K. Vánky, 1985:113.

Uredo (Ustilago) andropogonis Opiz, 1824:43 (as *andropogi*). — *Sphacelotheca andropogonis* (Opiz) Bubák, 1912:25. — *Cintractia andropogonis* (Opiz) Kochman, 1936:75. — Type on *Andropogon angustifolius* Sib. & Sm. (= *Dichanthium ischaemum* (L.) Roberty), Czech Rep., Dablizerberg [= Ďáblice] Mt., near Prague, F. M. Opiz. (I did not see the type, but there are several samples of this species in PRM with Opiz's handwritten labels, collected in or around Prague, with or without the date of collection).

Ustilago ischaemi Fuckel, 1860:22. — *Cintractia ischaemi* (Fck.) H. & P. Sydow, 1901:12. — *Sphacelotheca ischaemi* (Fck.) G. P. Clinton, 1902:140. — Type on *Andropogon ischaemum* (= *Dichanthium ischaemum* (L.) Roberty), Germany, Nassovia [= Nassau], Biebrich near Wiesbaden, leg. L. Fuckel.

Ustilago cylindrica Peck, 1882:55. — Type on *Andropogon* (?), USA, Arizona, VI., C. G. Pringle.

Sphacelotheca heteropogonis-triticei L. Ling, 1950:77. — Type on *Heteropogon triticeus* (R. Br.) Stapf, Philippine Islands, Luzon, Pangasinan Prov., south of Alaminos, III.1928, M. S. Clemens, BPI 177833!

For description and illustration of this species see Vánky, 1994:198-209.

On *Andropogon*, *Dichanthium* and *Heteropogon* species (e.g. *H. contortus* (L.) Beauv. ex Roem. & Schult., and *H. triticeus* (R. Br.) Stapf), world-wide.

2. *Sporisorium caledonicum* (Patouillard) K. Vánky, 1991:165.

Sorosporium caledonicum Patouillard, 1887:173. — Type on *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., New Caledonia, 1868-1870, coll. M. Balansa, PC!

Sorosporium heteropogonis-contorti Baccarini, 1917:132. — Type on *Heteropogon contortus*, Abyssinia [Ethiopia], Galla Arussi, on the left river-bank of Hauasch, alt. 1450 m, 8.VII.1909, F. Negri 1140, FT!

Sori comprise the whole inflorescence, 0.5–1.5 x 5–30 mm or longer, partly enclosed by the uppermost leaf sheath, first covered by a yellowish-brown peridium which early ruptures and becomes lacerated exposing the black, agglutinated to granular powdery mass of spore balls and several, long, filiform columellae. *Spore balls* globose, ovoid, ellipsoidal or irregular, 25–70 x

30–110 µm, dark reddish-brown to opaque, composed of numerous (25?–150? or more?) rather firmly united spores. *Spores* subglobose, ovoid, ellipsoidal to subpolyhedrally irregular, 7–12 x 8–13(–14) µm; outer spores dark reddish-brown; wall slightly uneven, 1–1.5 µm thick, rather densely and evidently punctate-echinulate giving the spore profile a wavy or very finely serrulate aspect; inner spores paler, thin-walled (c. 0.5 µm), apparently smooth to very finely punctate. Peridium composed of longitudinally arranged, firmly united chains of elongated, hyaline fungal cells which, with time, more or less loose their individuality.

On *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., world-wide, in the tropics and subtropics, wherever the host plant occurs.

3. ***Sporisorium contortum*** (Griffiths) K. Vánky, 1991:165.

Sorosporium contortum Griffiths, 1904:83. — Type on *Andropogon contortus* L. (= *Heteropogon contortus*), USA, Arizona, Santa Rita Mts., 12.IX.1902, D. Griffiths. [The "types" in BPI 195119!, 179680!, 179686!, 179688–90!, 179674!, and in WSP 34485 do not contain this fungus; see below].

Sori as in *Sporisorium caledonicum*, from which it differs in having looser spore balls composed of smaller spores, measuring 5–7 x 5.5–8 µm. The spores of *S. contortum* are apparently smooth to finely punctate.

On *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., North America (USA) and Europe (Spain).

In the original description, the spores of *Sorosporium contortum* are stated to be 5–8 µm, while Clinton (1904:413) gives 9–13 µm for the length of the spores. Zundel (1953:57) commented on this discrepancy in spore measurements and wrote: "An examination of the type material shows the original description to be correct". Durán (1987:58) studied the type (WSP 34485) and considered *Sorosporium contortum* to be a synonym of the earlier described *S. caledonicum*, giving 7–12 µm for the spore measurements. I examined tens of samples of smutted *Heteropogon contorus* of the type collection (holo-, iso- and topotypes) of *S. contortum*, preserved in BPI. In these, I was unable to find spores measuring 5–8 µm (only a mixture with a few samples of *S. moniliferum*, e.g. in BPI 179688, 179689, which can easily be distinguished from *S. contortum*). However, I have seen a fragment of smutted ?*Heteropogon contortus* in which the spores agree with the description of *S. contortum*, measuring 5–7 x 5.5–8 µm. The sample was collected by L. Guyot in Spain, between Cádiz and Tarifa, 25.VII.1954 (PC!).

In conclusion, the "type" collections of *S. contortum* in BPI, seen by me, contain a great number of *Heteropogon contortus* infected by *S. caledonicum* and a few plants infected by *S. moniliferum*. Only the "small-spored" sample(s) is missing, on which the original description was made and which was also seen by Zundel.

4. ***Sporisorium filiforme*** (Hennings) K. Vánky, **comb. nov.**
Basionym: *Ustilago filiformis* Hennings, Bot. Jahrb. Syst. 30:254, 1901 (not *U. filiformis* (Schrank) Rostrup, 1890). — *Sorosporium filiforme* (Henn.) Zundel (as "*filiformis*"), 1930:153. — Type on *Andropogon contortus* L. (= *Heteropogon contortus*), Tanzania, Usafua, Utengule, 20.VI.1899, W. Goetze 1059. Holotype in BPI 160436!, isotypes in BPI 160437! & 160438!

Sori in some ovaries of a raceme, long-cylindrical, c. 1 mm wide, up to 4 cm long, first covered by a pale yellowish-brown peridium which ruptures longitudinally disclosing the black, granular-powdery mass of spore balls and sterile cells, surrounding 3–6, long, filiform columellae. *Spore balls* globose to ellipsoidal or slightly irregular, 40–70 x 45–90 µm, dark reddish-brown, composed of tens of easily separating spores. *Spores* globose, subglobose, broadly ellipsoidal to slightly irregular, 9–11 x 10–13(–14) µm, reddish-brown; outer and inner spores similar; wall even, c. 1 µm thick, including the moderately densely situated spines, spore profile serrulate. *Sterile cells* numerous, in chains or in irregular groups, single cells globose to ellipsoidal, 12–16 µm long, subhyaline to pale yellowish-brown; wall c. 0.8 µm thick, smooth.

On *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., Africa (Tanzania).

5. ***Sporisorium glutinosum*** (Zundel) K. Vánky, **comb. nov.**
Basionym: *Sorosporium glutinosum* Zundel, Mycologia 36:407, 1944. — Type on *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., Mauritius, near Reduit (without date and name of collector), Dept. of Agriculture, Div. Plant Pathology, Mauritius, Exsicc. D 208; BPI 18007! & 195133!

Tolyposporium andropogonis M. K. Patel & N. B. Kulkarni, in Patel, Gokhale & Kulkarni, 1951:65. — *Sorosporium andropogonis* (Patel & N. B. Kulk.) Thirumalachar & Neergaard, 1977(1978):182. — Type on *Andropogon triticeus* R. Br. (= *Heteropogon triticeus*), India, Poona, Vetal Hill, X.1950, N. B. Kulkarni, HCIO 20076!

Sori destroying the whole inflorescence, long cylindrical, 0.5–1 mm x 4–9 cm, partly enclosed by the terminal leaf-sheath, first covered by a yellowish-brown peridium which shreds and flakes away exposing the black, granular-powdery mass of spore balls intermixed with several, long, slender columellae. *Spore balls* subglobose, ovoid, elongated or slightly irregular, loose but rather permanent, 25–45 x 30–70(–75) µm, dark reddish-brown, composed of 9–25(–40?) spores, held together by a colourless gelatinous fungal substance filling the space between the spores. *Spores* subglobose, ovoid, broadly ellipsoidal or subpolyhedrally irregular; outer spores 10.5–15 x 12–18.5 µm, reddish-brown, wall unevenly thick (1–2.5 µm), the free surface rather densely, more or less prominently verrucose-echinulate, spore profile wavy to serrulate, contact sides apparently smooth; inner spores somewhat smaller, lighter, with a thin (c. 0.5 µm), smooth wall. *Sterile cells* not seen.

On *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., and *H. triticeus* (R. Br.) Stapf ex Craib, S. Africa (incl. Mauritius), S. Asia, Australia.

6. **Sporisorium heteropogonicola** (Mundkur & Thirumalachar) K. Vánky, in Shivas & Vánky, 1997:839.

Sorosporium heteropogonicola Mundkur & Thirum., in Thirumalachar & Mundkur, 1951:5. — Type on *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., India, Mysore, Nandi Hills, 18.XI.1944, M. J. Thirumalachar, HCIO 10785!

For description and illustration see Shivas & Vánky, 1997:839-849.

On *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., North America (Mexico), S. Africa (Zimbabwe), S. Asia (India), and Australia.

7. **Sporisorium moniliferum** (Ellis & Everhart) L. Guo, 1990:82.

Ustilago monilifera Ellis & Everhart, 1895:362. — *Sphacelotheca monilifera* (Ell. & Ev.) G. P. Clinton, 1902:141. — Type on *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., USA, Arizona, Tucson, V.1893, J. W. Toumey 2.

Ustilgo andropogonis-contorti Hennings, nom. herb; in Clinton, 1902:141 (nomen nudum). — On *Andropogon contortus* L. (= *Heteropogon contortus*), Mexico.

Ustilgo warneckeana Hennings, 1907:119. — *Sphacelotheca warneckeana* (Henn.) Zundel, 1930:137. — Type on *Andropogon contortus* L. (= *Heteropogon contortus*), Togo, Lome, at the Lagune, XII.1899, Warnecke 3, HUV 13342!

Sphacelotheca ischaemi (Fuckel) G. P. Clinton f. *heteropogonis* Baccarini, 1917:131. — Type on *Heteropogon contortus* (L.) Beauv. ex Roem. & Schult., Abyssinia [Ethiopia], Galla Arussi, on the river-bank of Hauasch, alt. 1450 m, 8.VII.1909 (as "2.VII.1909"), F. Negri 1148/b, FT!

Sori in all ovaries of a raceme, often comprising also the innermost floral envelopes, short cylindrical, 1 x 3–6 mm, more or less concealed by the glumes, first covered by a dark brown, leathery peridium which ruptures from its apex disclosing the first agglutinated later powdery mass of spores and sterile cells surrounding a simple, tapering, central columella. *Spore balls* loose, composed of a great number of easily separating spores. *Spores* globose, broadly ellipsoidal to slightly irregular, 8–11 x 9–12.5 µm, yellowish- or reddish-brown; wall even, c. 1 µm thick, densely, finely echinulate, spore profile finely serrulate. *Sterile cells* in irregular groups, single cells globose, ellipsoidal or irregular, 8–16 µm long, subhyaline to pale yellowish-brown; wall c. 0.5 µm thick, smooth.

On *Heteropogon betafensis* A. Camus (Madagascar), *H. contortus* (L.) Beauv. ex Roem. & Schult., and *H. melanocarpus* (Ell.) Benth. This is the most common smut of *H. contortus*, in the tropics and subtropics of the Old and New world, following its host.

Hennings (1907:119) described the spores of *Ustilago warneckeana* as being reticulate-verrucose. This could not be confirmed by the study of the type, which is identical with *S. moniliferum*.

8. ***Sporisorium nealii*** (Ellis & Anderson) K. Vánky, **comb. nov.**
Basionym: *Ustilago nealii* Ellis & Anderson, J. Mycol. 6:116, 1891. — *Sphacelotheca nealii* (Ellis & Anderson) G. P. Clinton, 1904:389. — Type on *Heteropogon melanocarpus* (Ell.) Benth., USA, Florida, Lake City, 1890, J. C. Neal, BPI 190154.

Sori in some ovaries or spikelets of an inflorescence, cylindrical or ovoid, 2–3 x 3–5 mm, often forming conspicuous nodules at basal part of the racemes or raceme axis, 0.5–1 x 1–2 cm, first covered by a whitish peridium which ruptures irregularly from apex disclosing the semi-agglutinated, dark brown mass of spores, sterile cells and one to several slender columellae. *Spores* when mature single, variable in shape and size, globose, ovoid, long ellipsoidal, pyriform or irregular, 6–8 x 6.5–11(–12) µm, yellowish-brown; wall even, c. 0.5 µm thick, sparsely punctate-echinulate which does not affect the spore profile, in SEM, between the spines, densely, finely verrucose. *Sterile cells* in irregular groups, single spores globose, ellipsoidal, usually irregular with one or several flattened sides, 5–11 µm long, hyaline; wall thin (c. 0.5 µm), smooth.

On *Heteropogon melanocarpus* (Ell.) Benth., N. America (Mexico, USA), C. & S. Africa (Congo, Nyasaland, Zimbabwe), S. Asia (India).

Tolyposporium philippinense H. & P. Sydow, 1912:78, type on *Andropogon contortus* L. (= *Heteropogon contortus*), Philippine Islands, Luzon, near Manila, XI-XII.1910, E. D. Merrill 7423! is a ***Cerebella*** sp. (Fungi Imperfecti; comp. also Zundel, 1930:126, and Ainsworth, 1941:97).

Key to the smut fungi (*Sporisorium*) of *Heteropogon*.

1. Sori in the whole inflorescence 2
– Sori not in the whole inflorescence 5
2. Spores 12–18.5 µm long. .... *S. glutinosum*
– Spores smaller 3
3. Spores 5.5–8 µm long .... *S. contortum*
– Spores 8–13 µm long 4
4. Spore balls permanent, spores dissimilar, spore wall uneven,
0.5–1.5 µm thick, punctate-echinulate .... *S. caledonicum*
– Spore balls ephemeral, spores similar, spore wall even,
0.5–1 µm thick, finely punctate-verrucose .... *S. andropogonis*
5. Sori in some ovaries or spikelets, and at basal part of the
racemes or raceme axis producing conspicuous nodules .... *S. nealii*
– Sori in ovaries or spikelets, not producing nodules 6
6. Spore balls semi-permanent, 45–180(–260) µm long.
Spore wall uneven, 1–2.5 µm thick .... *S. heteropogonicola*
– Spore balls loose, smaller. Spore wall even, c. 1 µm thick 7
7. Sori in all ovaries or spikelets of a raceme, 3–6 mm long.
Peridium dark brown .... *S. moniliferum*
– Sori in some ovaries of a raceme, up to 40 mm long.
Peridium pale yellowish-brown .... *S. filiforme*

THE SMUT FUNGI OF *EULALIA* AND *EULALIOPSIS* (GRAMINEAE)

Eulalia Kunth, with c. 30 species in the Old World tropics, and *Eulaliopsis* Honda, with two species from Afghanistan to China and the Philippines, belong to the subfamily Panicoideae, tribe Andropogoneae, subtribe Saccharinae. *Eulalia* is related to *Saccharum*. *Eulaliopsis* is a rather isolated genus, regarded as a derivative of *Eulalia* (Clayton & Renvoize, 1986:333). *Eulalia* species were often treated under the generic name of *Pollinia* Spreng., nom. rejic. (= *Chrysopogon* Trin.). On *Eulalia*, *Eulaliopsis* and *Pollinia distachya* six smut fungi could be recognised.

1. ***Sporisorium crypticum*** (Cooke & Massee) K. Vánky & M. S. Patil, **comb. nov.** Basionym: *Cintractia cryptica* Cooke & Massee, in Cooke, Grevillea 18:34, 1889. — *Ustilago (?) cryptica* (Cooke & Massee) Ciferri, 1928:33. — *Sorosporium crypticum* (Cooke & Massee) L. Ling, 1949:131. — Type on *Pollinia argentea* (Brongn.) Trin. (= *Eulalia trispicata* (Schult.) Henr.), India, Munepore, coll. C. B. Clarke, BPI 194430!, HCIO!

Sori in all spikelets of an inflorescence, long cylindrical, tapering at base and apex, 0.5–0.8 x 4–8 mm, partly hidden by the outer floral envelopes, first covered by a thin, translucent, cream coloured peridium which ruptures irregularly disclosing the black, agglutinated to granular-powdery mass of spore balls surrounding 1(–2) filiform columellae. *Spore balls* subglobose, ovoid to slightly irregular, 30–55 x 35–70 µm, dark reddish-brown, almost opaque, composed of 15–70? or more? spores which separate by pressure. *Spores* variable in shape, size and colour; outer spores ellipsoidal, elongated, usually slightly irregular, 11–15 x 11.5–20 µm, dark reddish-brown; wall very uneven, 1–3 µm thick, thickest at the angles, prominently verrucose on the free surface. Inner spores rounded, subpolyhedrally irregular, 9.5–12 x 11–13.5 µm, pale yellow to pale yellowish-brown; wall thin, c. 0.5 µm, apparently smooth. *Sterile cells* between the spores not seen.

On *Eulalia trispicata* (Schult.) Henr. (*Eulalia argentea* Brongn., *Pollinia argentea* (Brongn.) Trin.), S. Asia (India).

2. ***Sporisorium polliniae*** (P. Magnus) K. Vánky, 1983:331.

Sorisporium polliniae Magnus, 1900:433. — Type on *Pollinia distachya* (L.) Sprengel, Judaea [= Israel], Jaffa Distr., Bab-el-Wad, 15.V.1897, J. Bornmüller 1015. Isotypes in Bornmüller, Iter syriacum 1897, No. 1015, BPI 180134!

Sorosporium icosiense Maire, 1917:145 — Type on *Andropogon distachyos* L. (= *Pollinia distachya*), Algeria, near Icosium, Télemly, El-Biar, coll. R. Maire.

Sori in all spikelets of an inflorescence, cylindrical or corniculate, 1–1.5 x 7–10 mm, partly hidden by the glumes, covered by a yellowish-brown peridium which splits longitudinally in several places exposing the blackish-brown, granular-powdery mass of spore balls and a central, filiform, sometimes apically bifurcate columella. *Spore balls* subglobose, ellipsoidal to irregular, 20–40 x 25–55 µm, reddish-brown, composed of few to many (10–40 or more?) spores, initially firm but disintegrating readily at maturity. *Spores* subglobose, ellipsoidal, usually slightly subpolyhedrally irregular, 7–11 x 8–14 µm, yellowish- to reddish-brown, verrucose to echinulate on the free surface, punctate to apparently smooth on the contact sides; wall uneven, 1–2 µm thick, thickest at the angles and on the free surface. *Sterile cells* between the spore balls not seen. The peridium is composed of long chains of hyaline, thin-walled, elongated or irregular cells (8–16(–20) µm long), with 1(–2) oil droplets. *Spore germination* (on potato-glucose-agar, at room temp., in 2 days) results in long, 4-celled basidia with fusiform basidiospores on short sterigmata at the septa and on the apex of the basidium.

On *Andropogon distachyos* L. (*Pollinia distachya* (L.) Sprengel; *Chrysopogon distachyos* (L.) Rossi), Mediterranean region (Europe, Africa, Asia).

3. ***Sporisorium indicum*** (H. & P. Sydow & Butler) K. Vánky, **comb. nov.** Basionym: *Ustilago indica* H. & P. Sydow & Butler, Ann. Mycol. 10:250, 1912. — Type on *Ischaemum angustifolium* (Trin.) Hackel (= *Eulaliopsis binata* (Retz.) C. E. Hubb.), India, Punjab State, Pathankot, 22.V.1911, J. H. Mitter (E. J. Butler No. 1430), HCIO 7478!

Sori destroying the whole inflorescence, partly or completely enclosed by leaf sheaths, 1–3 mm x 1–3 cm, first covered by a thick peridium of host and fungal origin which ruptures irregularly disclosing the blackish-brown spore masses intermixed with sterile cells, surrounding an irregular, central columella with several, short, lateral branches. Sori may be confined only to some or all spikelets of an inflorescence, then smaller. *Spores* when young in loose, irregular balls, when mature single, globose, subglobose to broadly ellipsoidal, rarely irregular, 5–7(–8) x 5.5–8(–9) µm, yellowish- to reddish-brown; wall even, c. 0.5 µm thick, from apparently smooth to finely, sparsely verrucose-echinulate which does not or only slightly affects the spore profile. *Sterile cells* larger than the spores (7–18 µm long), globose, broadly ellipsoidal, rarely irregular, subhyaline, single or in irregular groups; wall 1–4 µm thick, smooth.

On *Eulaliopsis binata* (Retz.) C. E. Hubb. (*Ischaemum angustifolium* (Trin.) Hackel), S. Asia (India, Pakistan).

Spore ornamentation, size and wall thickness of sterile cells may vary between different collections. For example, the spores of the type specimen are inconspicuously ornamented, the sterile cells are somewhat smaller and have a thinner wall, whereas in three other collections from Pakistan, seen by me, the spores are more evidently ornamented, the sterile cells are somewhat larger with thicker wall. These differences are considered variations within the same taxon.

4. ***Sporisorium pollinianum*** (Zundel) K. Vánky & R. G. Shivas, **comb. nov.** Basionym: *Sphacelotheca polliniana* Zundel, Mycologia 35:174, 1943. — Type on *Pollinia leptostachys* Pilger (det. A. Chase), Papua New Guinea, Morobe Prov., Kajabit Mission, alt. 800–1000 ft., 31.VIII.1939, M. S. Clemens 10633, BPI 194901!

Sori in all spikelets of an inflorescence, more or less completely destroying them, ovoid to cylindrical, 1–1.5 x 1.5–5(–6) mm, occasionally larger by confluence, first covered by a brown peridium which ruptures exposing the blackish-brown mass of spores and a central, flagelliform columella. *Spore balls* ephemeral, subglobose, ellipsoidal or irregular, 35–60 x 40–80 µm, reddish-brown. *Spores* uniform, subglobose to ovoid, rarely slightly irregular, 9.5–11.5 x 9.5–13 µm, yellowish-brown; wall even, c. 1 µm thick, regularly, finely, moderately densely echinulate. *Sterile cells* in pairs or in short chains, variable, subglobose, ellipsoidal, usually with flattened contact sides, 5–15 µm long, tinted yellowish-brown; wall thin (c. 0.8 µm), smooth.

On *Eulalia leptostachys* (Pilger) Henrard (*Pollinia leptostachys* Pilger), Australasia (Papua New Guinea).

In the original description of *Sphacelotheca polliniana* the spores are given as smooth.

5. ***Sporisorium eulaliae*** (L. Ling) K. Vánky, 1997a:137.

Sorosporium eulaliae L. Ling, 1953:155. — Type on *Eulalia trispicata* (Schultes) Henrard, Australia, Queensland, N. of Mackay, 21.VIII.1941, R. F. N. Langdon. Holotype in IMI 43721!, isotype in BPI 179840!

Sori in all spikelets of the inflorescence, fusiform-cylindrical, 0.5–1 x 4–5 mm, partly hidden by the glumes, first covered by a brown peridium which lacerates into stripes exposing the dark brown, granular-powdery mass of spore balls surrounding a filiform, simple or shortly ramifying central columella. *Spore balls* globose, ellipsoidal to oblong or slightly irregular, 30–75 x 33–90 µm, dark reddish-brown, composed of tens of spores which separate rather easily at maturity. *Spores* variable in shape, size and colour; outer spores globose, ellipsoidal, ovoid to irregular, 8–12 x 9.5–15 µm, reddish-brown, prominently verrucose to echinulate on the free surface; wall uneven, 1–2(–2.5) µm thick, thickest at the angles and on the free surface. Inner spores polyangularly irregular, 7–9.5 x 8–12 µm, almost hyaline to pale yellow; wall thin, c. 0.5 µm, apparently smooth. *Sterile cells* between the spores not seen.

On *Eulalia trispicata* (Schult.) Henr. (*Eulalia argentea* Brongn., *Pollinia argentea* (Brongn.) Trin.), Australia.

6. ***Sporisorium guangxiense*** L. Guo, 1999:235.

Type on *Eulalia pallens* (Hackel) O. Kuntze, China, Guangxi Prov., Shangsi, 15.XI.1958, Liu Heng-ying 400. Holotype in HMAS 74197 (n. v.).

Sori in all spikelets, ovoid or cylindrical, 1–1.5 x 2–4 mm, first covered by a thin, whitish peridium which ruptures disclosing the blackish-brown, powdery mass of spores and a central columella. *Spores* subglobose, ovoid or ellipsoidal, 5–7 x 6–9 µm, yellowish-brown; wall 1–1.5 µm thick, uneven, thicker on two sides, densely and minutely verruculose. *Sterile cells* 5–11 x 6–11.5(–14) µm, yellow, smooth, in short chains (Description taken from the original).

On *Eulalia pallens* (Hackel) O. Kuntze (*Pollinia pallens* Hackel), Asia (China).

Key to the smut fungi (*Sporisorium*) of *Eulalia* and *Eulaliopsis*.

1. Spore balls ephemeral. Spores uniform. Sterile cells present 2
– Spore balls semipermanent. Spores variable. Sterile cells absent 4
2. Spores 5.5–9 µm long 3
– Spores 9.5–13 µm long .... *S. pollinianum*
3. Spore wall 1–1.5 µm thick, uneven. On *Eulalia* .... *S. guangxiense*
– Spore wall 0.5 µm thick, even. On *Eulaliopsis* .... *S. indicum*
4. Spore balls 25–55 µm long, of relatively few spores (10–40?). Spores 8–14 µm long .... *S. polliniae*
– Spore balls larger, of more spores. Spores larger 5
5. Outer spores 9.5–15 µm long, spore wall slightly uneven, 1–2(–2.5) µm thick .... *S. eulaliae*
– Outer spores 11.5–20 µm long, spore wall very uneven, 1–3 µm thick .... *S. crypticum*

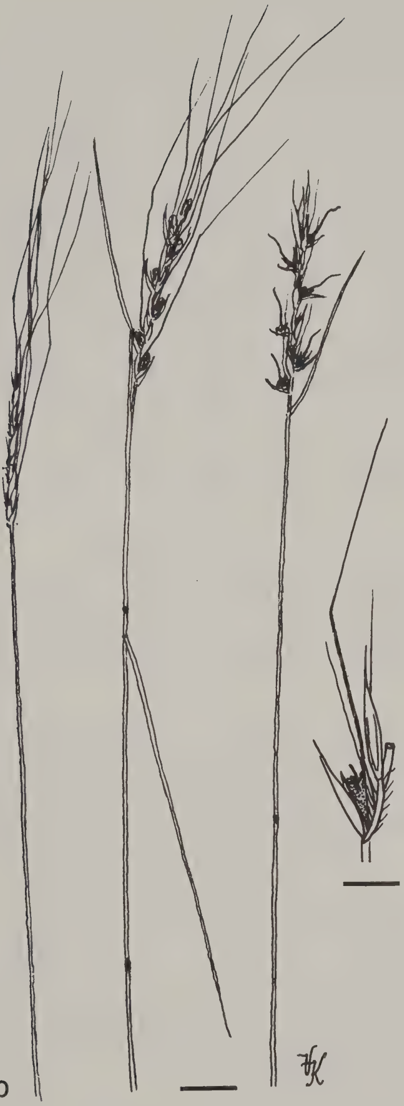
THE SMUT FUNGI OF *SEHIMA* AND *TRIPLOPOGON* (GRAMINEAE)

Sehima Forssk., with five species from Old World tropics, and the monospecific *Triplopogon* Bor belong to the subfamily Panicoideae, tribe Andropogoneae, subtribe Ischaeminae. "The genus *Sehima* is remarkably uniform . . . . It can be regarded as a segregate from *Ischaemum*" (Clayton & Renvoize, 1986:348). Until now, no smut fungi are known on *Triplopogon*. On *Sehima* two smut fungi have been described, *Sorosporium sehimae* M. S. Patil, and *S. sulcati* M. S. Patil, both belonging to the genus *Sporisorium*. An additional species was recently collected in Zimbabwe.

1. ***Sporisorium sehimicola*** K. Vánky, **sp. nov.**

Typus in matrice *Sehima ischaemoides* Forssk., Zimbabwe, Matabeleland North Prov., Hwange (Wankie) National Park, 15 km N. Robins Camp, "Tshowe Loop", 18°33'49" S, 25°59'44" E, alt. cca. 930 m.s.m., 11.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18900!, isotypi in BPI et in Vánky, Ust. exs. No. 1063 (ineditus). Paratypus in matrice *Sehima ischaemoides*, Sudan, Jebel Fau, 1.XII.1952, J. K. Jackson 2472, IMI 51513!

Sori in spiculis sessilibus, hermaphroditis, duas glumas et lemmata aristata intacte relinquentes, raro etiam in spiculis sterilibus pedicellatis. Sori juveniles subcylindrici, 1–1,5 x 3–4 mm, peridio brunneo cooperti, quo maturitate irregulariter rupto, massam sporarum atrobrunneam, pulveream, cum catervis cellularum sterilium intermixtam ostendentes. Columella conspicua, usque ad 1 cm longa, simplex vel apicaliter breviter ramificata, attenuata praesens. Pars distalis peridii saepe residua organorum floralium internorum et antheras abortivas gerens. *Sporae* maturitate singulae, subglobosae, ovoideae, ellipsoidales vel irregulares, (9–)9,5–11(–12) x 10–13 µm, olivaceobrunneae, cum residuis parvis hypharum sporogenarum quasi maculis claris, echinulatae; pariete aequali, cca. 1 µm crasso spinis dense dispositis, subtilibus sed conspicuis inclusis; sporae ex obliquo subtiliter serrulatae. *Cellulae steriles* forma et magnitudine variae, subglobosae, ellipsoidales vel irregulares, 7–17 µm longae, in catervis



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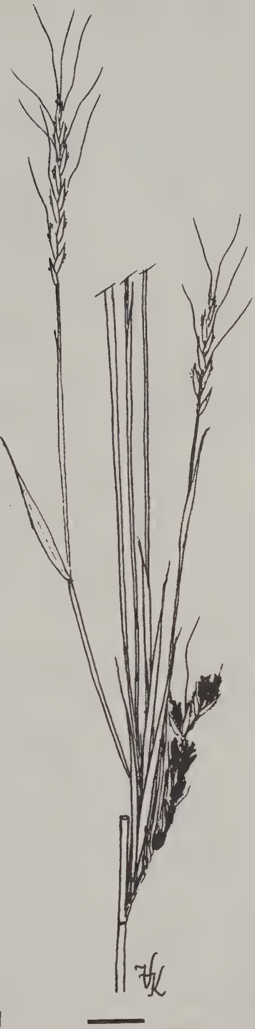

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Fig. 10. *Sporisorium sehimicola* K. Vánky on *Sehima ischaemoides* Forssk. A healthy and two infected racemes, of which one is young (in the middle) and the other is older (to the right). Enlarged a spikelet pair of which the sessile, hermaphrodite spikelet is infected whereas the pedicelled, neuter spikelet is intact (type). Bars = 1 cm and, for the detail picture, 5 mm.

Fig. 11. *Sporisorium triplopogonis* K. Vánky on *Triplopogon ramosissimum* (Hackel) Bor (type), and two healthy racemes. Bar = 1 cm.

irregularibus, vel nonnunquam singulae, hyalinae; pariete aequali, 1–1,5 µm crasso, levi.

Sori (Fig. 10) in the sessile, hermaphrodite spikelets, leaving intact the two glumes and the awned lemma, rarely also in the pedicelled, neuter spikelet. Young sori subcylindrical, 1–1.5 x 3–4 mm, covered by a brown, leathery peridium which ruptures irregularly at maturity disclosing the blackish-brown, powdery mass of spores intermixed with groups of sterile cells. An evident, up to 1 cm long, simple or apically shortly ramifying, tapering columella is present. The distal part of the peridium often bears remnants of inner floral organs and aborted anthers. *Spores* (Figs. 7, 8) when mature single, subglobose, ovoid, ellipsoidal or irregular, (9–)9.5–11(–12) x 10–13 µm, olivaceous-brown, with small remnants of sporogenous hyphae as bright spots, echinulate; wall even, c. 1 µm thick including the densely situated, fine but evident spines, spore profile finely serrulate. *Sterile cells* (Figs. 7, 8) variable in shape and size, subglobose, ellipsoidal or irregular, 7–17 µm long, in irregular groups or sometimes single, hyaline; wall even, 1–1.5 µm thick, smooth.

On *Sehima ischaemoides* Forssk., Africa (Sudan, Zimbabwe).

2. ***Sporisorium sehimae*** (M. S. Patil) K. Vánky, **comb. nov.**

Basionym: *Sorosporium sehimae* M. S. Patil, Indian Phytopathol. 45:181, 1992. — Type on *Sehima nervosum* (Rottler) Stapf, India, Maharashtra State, Kolhapur, Shivaj University Campus, 20.IX.1981, leg. M. S. Patil. Holotype in HCIO 3011!, isotype in HUV 15218! Topotype: 16.XI.1995, leg. C. & K. Vánky, HUV 17467!

Sori in some of the sessile, hermaphrodite spikelets of an inflorescence, leaving intact the glumes, the awned lemma and the pedicelled spikelets, cylindrical, 1–2.5 x 5–10 mm, covered by a yellowish-brown, thick peridium which ruptures from its apex disclosing the blackish-brown, granular-powdery mass of spore balls and 5–7 filiform columellae. *Spore balls* variable in shape and size, subglobose, ellipsoidal, usually elongated or irregular, 40–140 x 50–160(–200) µm, dark reddish-brown to opaque, composed of many (tens to hundreds) spores which hardly separate by pressure. *Spores* subglobose, ellipsoidal or usually subpolyhedrally irregular, 6.5–9.5 x 7–10.5(–11) µm, yellowish to pale reddish-brown; wall thin (0.5–0.8 µm), apparently smooth to very finely punctate, especially the outer spores in the ball, which are also somewhat darker than the inner, thin-walled spores.

On *Sehima nervosum* (Rottler) Stapf, S. Asia (India).

3. ***Sporisorium sulcati*** (M. S. Patil) K. Vánky, **comb. nov.**

Basionym: *Sorosporium sulcati* M. S. Patil, Indian Phytopathol. 45:181, 1992. — Type on *Sehima sulcatum* (Hackel) A. Camus, India, Maharashtra State, Kolhapur Distr., Panhala, 1.XI.1986, leg. S. R. Yadaw. Holotype in HCIO 3013, isotype in HUV 15134!

Sori in all sessile and pedicelled spikelets of an inflorescence, leaving intact the glumes as well as the awned lemma of the sessile spikelets, cylindrical, 0.5–1 x 5–8 mm, covered by a light brown peridium which ruptures irregularly from its apex disclosing the blackish-brown, first agglutinated, later granular-powdery mass of spore balls and a delicate, central columella. This is often composed of several filaments which may be fused or may be free in different segments of the columella. *Spore balls* variable in shape and size, most often irregular, rarely subglobose, ellipsoidal or elongated, 20–50 x 30–70(–100) µm, light to dark reddish-brown, composed of 15–50?(–100?), rather firmly united spores which separate by pressure. *Spores* subglobose, ellipsoidal, elongated or usually irregular, 7–11 x 8–12 µm; outer spores reddish-brown, wall uneven, 1–2(–2.5 µm), thickest at the angles, very finely punctate on the free surface; inner spores lighter, rounded subpolyhedral, wall thin (c. 0.5 µm), apparently smooth.

On *Sehima sulcatum* (Hackel) A. Camus, S. Asia (India).

Between specimens obtained in exchange from New Delhi, India (HCIO), there is an unkown smut fungus on *Sehima spathiflorum* (Hook. fil.) Blatt. & McCann. For this endemic plant a monospecific genus, *Triplopogon* Bor, has been erected.

4. ***Sporisorium triplopogonis*** K. Vánky, **sp. nov.**

Typus in matrice *Triplopogon ramosissimum* (Hackel) Bor, India, Maharashtra State, Thana Distr., 3.XII.1954, leg. R. R. Panje (sub *Sphacelotheca tanglinensis*). Holotypus in Herbario Ustil. Vánky, HUV 17311!, isotypus in HCIO 22119.

Sori spiculas, vel confusione partem racemi vel racemum totum destruentes, 2–3 x 8–20 mm vel longiores, peridio brunneo, coriaceo cooperti, quo maturitate irregulariter rupto massam glomerulorum sporarum atrobrunneam, pulveream, cum catervis cellularum sterilium intermixtam, columellam crassam, irregularem, ramulis nonnullis brevibus instructam circumdantem ostendentes. *Glomeruli sporarum* forma et magnitudine varii, subglobosi, ellipsoidales vel irregulares, 40–100 x 50–140 µm, atro-rufobrunnei usque opaci, e sporis pluries decem usque ad unum centum? satis leviter separabilibus compositi. *Sporae* globosae, ellipsoidales usque subpolyedrice irregulares, 8–11(–12) x 9,5–15 µm; sporae externae rufobrunneae, rotundatae, pariete saepe inaequaliter crasso (0,5–1 µm), leniter, dense verrucoso-echinulato; praesertim in superficie libera illic ex obliquo leniter serrulata; sporae internae parum minores, dilutiores, magis angulares, pariete saepe inaequaliter crasso, 0,4–0,8 µm, in angulis crassiore, conspicue levi usque leniter, dense punctato-verruculoso, ex obliquo levi vel paene levi. *Cellulae steriles* in catervis globosis, irregularibus usque elongatis, cellulae singulae forma et magnitudine variae, subglobosae, ovoideae usque plerumque irregulares cum lateribus deplanatis, 8–20 µm longae, in speciminibus vetustis collapsae, pallide flavae; pariete 0,5–1 µm crasso, levi.

Sori (Fig. 11) destroying the spikelets or, by confluence, a part or the whole raceme, 2–3 x 8–20 mm or longer, covered by a brown, leathery peridium which ruptures irregularly at maturity disclosing the dark brown, powdery mass of spore balls intermixed with groups of sterile cells surrounding a thick, irregular columella with several short branches. *Spore balls* (Figs. 13, 14) variable in shape and size, subglobose, ellipsoidal or irregular, 40–100 x 50–140 µm, dark reddish-brown to opaque, composed of tens to a hundred? of rather easily separating spores. *Spores* (Figs. 13, 14) globose, ellipsoidal to subpolyhedrally irregular, 8–11(–12) x 9.5–15 µm; outer spores reddish-brown, rounded, wall often unevenly thick (0.5–1 µm), finely, densely verrucose-echinulate, especially on the free surface where the spore profile is finely serrulate; inner spores somewhat smaller, lighter, more angular, wall often uneven in thickness, 0.4–0.8 µm, thicker at the angles, apparently smooth to finely, densely punctate-verruculose, spore profile smooth or nearly so. *Sterile cells* (Figs. 13, 14) in globose, irregular to elongated groups, single cells variable in shape and size, subglobose, ovoid to usually irregular with flattened sides, 8–20 µm long, collapsed in old specimens, pale yellow; wall 0.5–1 µm thick, smooth.

On *Triplopogon ramosissimum* (Hackel) Bor (*Sehima spathiflorum* (Hook. fil.) Blatt. & McCann, *Triplopogon spathiflorus* (Hook. fil.) Bor), S. Asia (India).

A NEW SMUT FUNGUS ON *TRACHYPOGON* (GRAMINEAE)

Trachypogon Nees, with c. 13 species in Africa and tropical America, belongs to the subfamily Panicoideae, tribe Andropogoneae, subtribe Germainiinae (Clayton & Renvoize, 1986:338). I revised the smut fungi of *Trachypogon* (Vánky, 1995b:206-210) and recognised seven species: *Sporisorium amphilophis* (H. Sydow) Langdon & Fullerton, *S. trachypogonicola* K. & C. Vánky, *S. trachypogonis* (Zundel) K. Vánky, *S. trachypogonis-plumosi* K. Vánky, *S. zundelianum* K. Vánky, *Tilletia trachypogonis* Durán, and *Tolyposporella puccinioides* Durán. Recently, an additional smut fungus was collected in Zimbabwe on *Trachypogon spicatus*. The same fungus was also collected earlier by H. Vanderyst and preserved in BR, without being named and described.

Sporisorium trachypogonis-spicati K. & C. Vánky, **sp. nov.**

Typus in matrice *Trachypogon spicatus* (L. fil.) Kuntze, Zimbabwe, Matabeleland South Prov., Matobo National Park, inter Toghwana Dam et Maleme Dam, 20°31'40" S, 28°33'15" E, alt. cca. 1390 m.s.m., 21.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18960!, isotypus in BPI. Paratypi in matrice *Trachypogon spicatus*, Congo, Prov. III, Banza Boma, VI.1915, leg. H. Vanderyst 5491, BR, HUV 18268!; Congo, Prov. IV, Kasongo-Lunda, 6°30' S, 16°51' E, 1925, leg. H. Vanderyst 17353, BR, HUV 18269!

Sori pares spicularum, rarius spiculas singulas vel catervas parium spicularum destruentes, transformantes eas in corpora atrobrunnea, cylindrica, 1–1,5 x 4–10(–20) mm, peridio crasso, satis persistenti, plerumque transversaliter rugoso cooperti, quo irregulariter in partes nonnullas rupto massam sporarum atrobrunneam, pulveream et cellularum sterilium, columellam crassam, centralem, saepe tortam et circinatam circumdantem ostendentes. *Sporae*

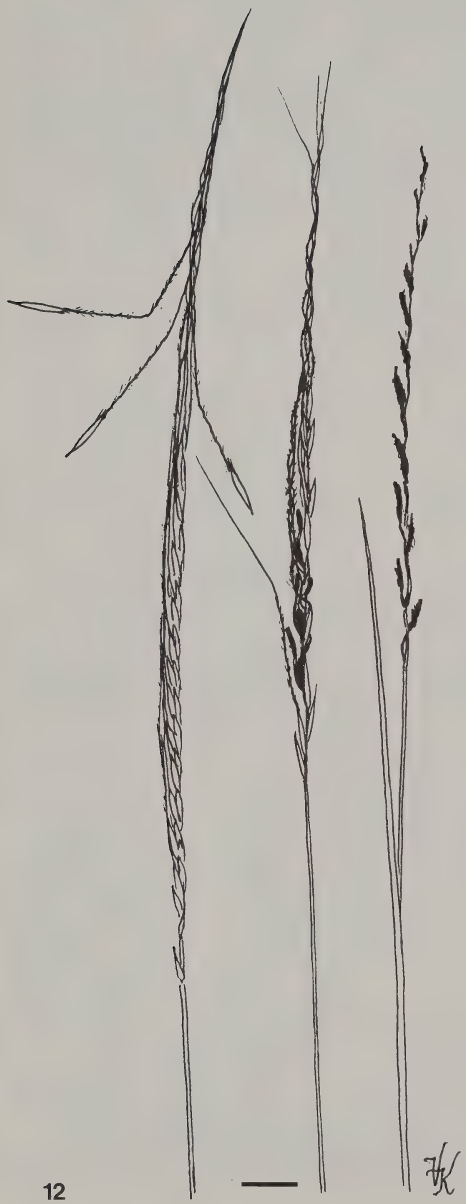


Fig. 12. Sori of *Sporisorium trachypogonis-spicati* K. & C. Vánky on *Trachypogon spicatus* (L. fil.) Kuntze. A healthy, a partially infected and a completely infectedand raceme with all spikelets destroyed (type). Bar = 1 cm.

maturitate singulae, late ellipsoidales, raro subglobosae, 6,5–8 x 7,5–9,5 µm, flavidobrunneae; pariete aequali, cca. 0,5 µm crasso, sub LM levi. *Cellulae steriles* singulae vel in catervis parvis irregularibus, cellulae singulae maiores quam sporae, 10–16 µm longae, subhyalinae, in speciminibus vetustis collapsae; pariete cca. 1 µm crasso, levi.

Sori (Fig. 12) destroying the spikelet-pairs, more rarely single spikelets or groups of spikelet-pairs, transforming them into dark brown, cylindrical bodies, 1–1.5 x 4–10(–20) mm, covered by a thick, rather persistent, usually transversely wrinkled peridium which ruptures irregularly in several places disclosing the dark brown, powdery mass of spores and sterile cells surrounding a thick, central, often coiled and twisted columella. *Spores* (Figs. 15, 16) when mature single, broadly ellipsoidal, rarely subglobose, 6.5–8 x 7.5–9.5 µm, yellowish-brown; wall even, c. 0.5 µm thick, in LM smooth. *Sterile cells* (Figs. 15, 16) single or in small, irregular groups, single cells larger than the spores, 10–16 µm long, subhyaline, collapsed in old specimens; wall c. 1 µm thick, smooth.

On *Trachypogon spicatus* (L. fil.) Kuntze, C. & S. Africa (Congo, Zimbabwe).

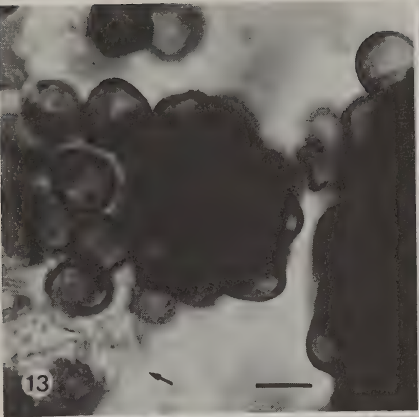
Key to the smut fungi of *Trachypogon*.

1. Sori on the adaxial surface of the leaves .... *Tolyposporella puccinioides*
– Sori elsewhere 2
2. Sori in the spikelets or in the whole inflorescence 3
– Sori in the ovaries 5
3. Sori in the spikelets. Spores smooth .... *Sporisorium trachypogonis-spicati*
– Sori in the whole inflorescence. Spores ornamented 4
4. Spores irregular, finely punctate .... *Sporisorium trachypogonicola*
– Spores regular, punctate-echinulate .... *Sporisorium amphilophis*
5. Spores 20–30 µm long .... *Tilletia trachypogonis*
– Spores smaller 6
6. Sori in all ovaries. Spores 5–8 µm long, verrucose ..... *Sporisorium zundelianum*
– Sori in some ovaries of an inflorescence. Spores larger, echinulate 7
7. Spores 7–16 µm long, with 1–3 µm high spines, often connected into irregular, incomplete meshes .... *Sporisorium trachypogonis*
– Spores 7–10 µm long, with 0.5–1.5 µm high, isolated tubercles or spines .... *Sporisorium trachypogonis-plumosi*

Figs. 13, 14. Spore balls, spores and sterile cells (arrow) of *Sporisorium triplopogonis* K. Vánky on *Triplopogon ramosissimum* (Hackel) Bor, in LM and in SEM (type). Bars = 10 µm.

Figs. 15, 16. Spores and sterile cells (arrow) of *Sporisorium trachypogonis-spicati* K. & C. Vánky on *Trachypogon spicatus* (L. fil.) Kuntze, in LM and in SEM (paratype; with remnants of mycelia of a mould). Bars = 10 µm.

Figs. 17, 18. Spore balls, spores and a sterile cell (arrow) of *Sporisorium hwangense* K. & C. Vánky on *Sporobolus panicoides* A. Rich., in LM and in SEM (type). Bars = 10 µm.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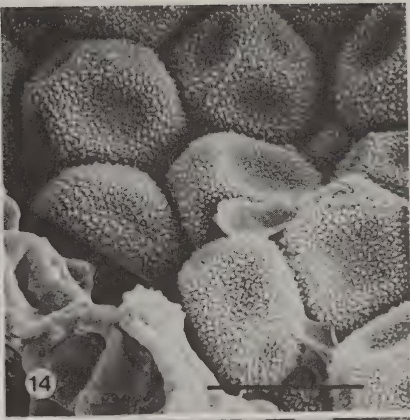
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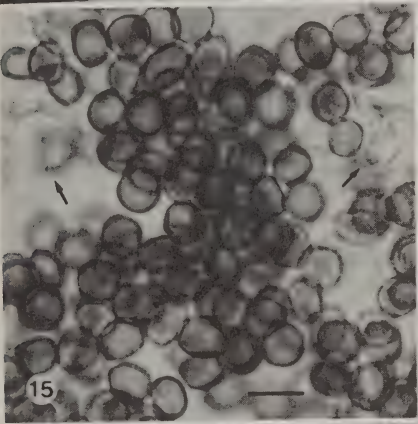
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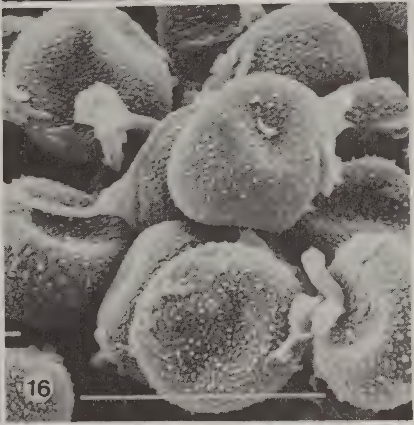
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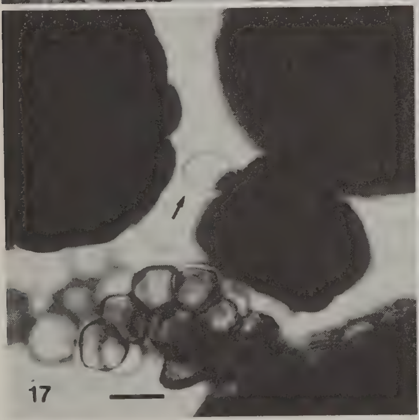
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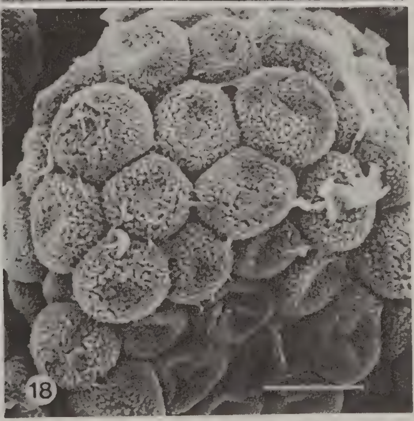
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TWO NEW SMUT FUNGI ON *SPOROBOLUS* (GRAMINEAE)

Sporisorium hwangense K. & C. Vánky, **sp. nov.**

Typus in matrice *Sporobolus panicoides* A. Rich., Zimbabwe, Matabeleland North Prov., Hwange (Wankie) National Park, Main Camp, Sedina Water Hole, 18°44'03" S, 26°57'06" E, alt. cca. 930 m.s.m., 6.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18888!, isotypi in BPI et in Vánky, Ust. exs. No. 1059 (ineditus).

Sori in ovariis, organa floralia interna etiam accipientes, cylindrici, 0,5–1 x 3–8 mm, primo peridio albido usque pallide flavidobrunneo cellularum fungalium in series arte compactas dispositarum et partim etiam strati externi cellularum hostalium cooperti. Peridio longitudinaliter ab apice eius rupto massa atrobrunnea, granuloso-pulverea glomerulorum sporarum cum cellulis sterilibus, columellam tenuem, simplicem, centralem, longitudine cum soro aequalem circumdantibus manifesta. *Glomeruli sporarum* forma et magnitudine varii, subglobosi, ellipsoidales, pyriformes, elongati vel irregulares, 30–70 x 30–100 µm, atro-rufobrunnei, usque opaci, satis permanentes, e sporis multis compositi. *Sporae* ellipsoidales usque subpolyedrice irregulares, 7–11 x 8–12(–13) µm; sporae externae atro-rufobrunneae, pariete cca. 1 µm crasso, dense verruculoso-echinulato in superficie libera ex obliquo leniter serrulato apparenti; sporae internae colore pallidiores, pariete tenui (cca. 0,5 µm), conspicue levi. *Cellulae steriles* plerumque singulae, globosae usque ellipsoidales, 6–13 x 7–15 µm, hyalinae; pariete 1–3 µm crasso, levi.

Sori (Fig. 19) in the ovaries comprising also the inner floral organs, cylindrical, 0.5–1 x 3–8 mm, first covered by a whitish to pale yellowish-brown peridium composed of fungal cells which are arranged in tightly packed rows, and partly also of an external layer of host cells. The peridium ruptures longitudinally from its apex disclosing the dark brown, granular-powdery mass of spore balls intermixed with sterile cells surrounding a slender, simple, central columella of the length of the sorus. *Spore balls* (Figs. 17, 18) variable in shape and size, subglobose, ellipsoidal, pyriform, elongate or irregular, 30–70 x 30–100 µm, dark reddish-brown to opaque, rather permanent, composed of numerous spores. *Spores* (Figs. 17, 18) ellipsoidal to subpolyhedrally irregular, 7–11 x 8–12(–13) µm; outer spores dark reddish-brown with a c. 1 µm thick wall, densely verruculose-echinulate on the free surface which appears finely serrulate in median view; inner spores lighter coloured, thin-walled (c. 0.5 µm), apparently smooth. *Sterile cells* (Figs. 17, 18) usually single, globose to ellipsoidal, 6–13 x 7–15 µm, hyaline; wall 1–3 µm thick, smooth.

On *Sporobolus panicoides* A. Rich., S. Africa (Zimbabwe).

Tilletia sporoboli K. Vánky, **sp. nov.**

Typus in matrice *Sporobolus festivus* A. Rich. (det. K. E. Bennett), Zimbabwe, Midlands Prov., 15 km N.W. urbe Zvishavane, 20°12'35" S, 29°57'51" E, alt. cca. 1020 m.s.m., 1.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18880!, isotypi in BPI, IMI 380468 and S.

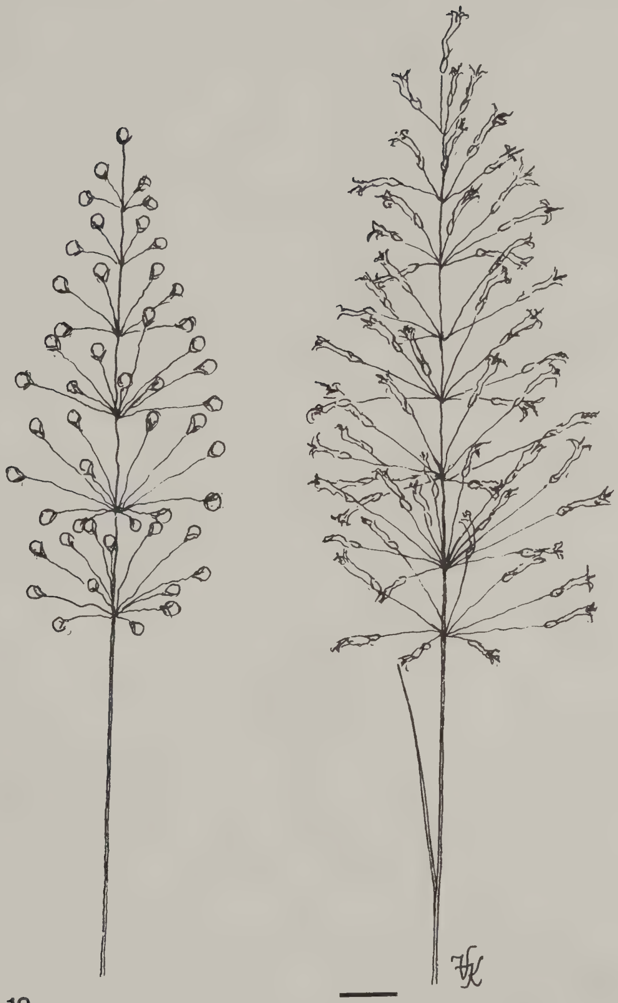

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Fig. 19. Sori of *Sporisorium hwangense* K. & C. Vánky in the spikelets of *Sporobolus panicoides* A. Rich. A healthy and an infected inflorescence (type). Bar = 1 cm.

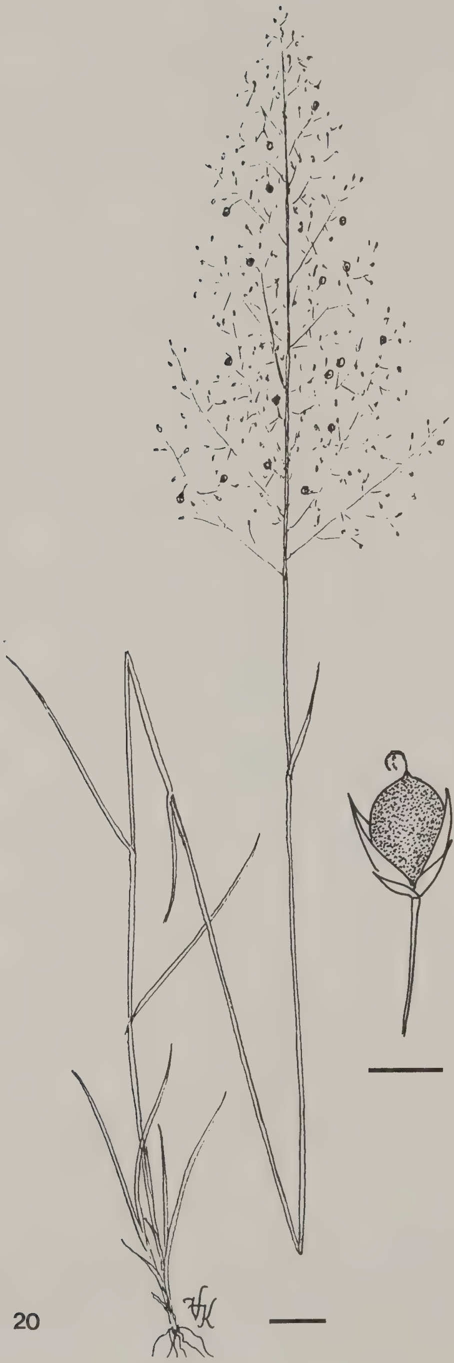

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Fig. 20. Sori of *Tilletia sporoboli* K. Vánky in some of the ovaries of *Sporobolus festivus* A. Rich. Enlarged a sorus (type). Bars = 1 cm (left) and 1 mm (right).

Sori in ovariis nonnullis inflorescentiae, globoidei usque late ellipsoidales, in diametro cca. 1 mm, pericarpio primo viridi, serius brunneo cooperti, quo irregulariter rupto massam rufobrunneam sporarum cum cellulis sterilibus intermixtam ostendentes. *Sporae* subglobosae, ovoideae, ellipsoidales usque parum irregulares, 13–18 x 16–21 µm, pallide flavae usque pallide rufobrunneae, frusto obtuso verrucarum pyramidibus similium 1,5–2,5 µm alto, grosso, aliquantum irregulari instructae. *Cellulae steriles* globosae usque ellipsoidales, magnitudine variae, 10–22 x 12–24 µm, hyalinae; pariete 1,5–3 µm crasso, levi.

Sori (Fig. 20) in some ovaries of the inflorescence, globoid to broadly ellipsoidal, c. 1 mm in diameter, covered by the at first green, later brown pericarp which ruptures irregularly disclosing the reddish-brown, granular mass of spores intermixed with sterile cells. *Spores* (Figs. 22, 23) subglobose, ovoid, ellipsoidal to slightly irregular, 13–18 x 16–21 µm, pale yellow to pale reddish-brown, provided with blunt, 1.5–2.5 µm high, coarse, somewhat irregular, blunt conical or frustra of pyramid-like warts. *Sterile cells* (Figs. 22, 23) globose to ellipsoidal, variable in size, 10–22 x 12–24 µm, hyaline; wall 1.5–3 µm thick, smooth.

On *Sporobolus festivus* A. Rich., S. Africa (Zimbabwe).

On *Sporobolus* two *Tilletia* species have been described: *T. asperifolia* Ellis & Everh., type on *Sporobolus asperifolius* Nees & Mey. (= *Muhlenbergia asperifolia* (Nees & Mey.) Parodi), and *T. montana* Ellis & Everh., type on *Sporobolus gracillimus* Vasey (= *Muhlenbergia filiformis* (Thurb.) Rydb.), both possessing reticulate spores.

THE SMUT FUNGI OF *TRICHOLAENA* (GRAMINEAE)

Tricholaena Schult. is a small genus of four species in the Mediterranean area, Africa to India, belonging to the subfamily Panicoideae, tribe Paniceae, subtribe Melinidinae (Clayton & Renvoize, 1986:295). On *Tricholaena* the following smut fungi have been described: **1**. *Entyloma farisii* Ciferri, type on *T. rosea* Nees (= *Rhynchelytrum roseum* (Nees) Stapf & C. E. Hubb. ex Bews, = *Melinis repens* (Willd.) Zizka), Dominican Republic, **2**. *Sporisorium tricholaenae* (Henn.) K. Vánky, type on *T. teneriffae* (L. fil.) Link, Egypt, **3**. *Ustilago cacheutensis* Speg., type on *Panicum leucophaeum* H. B. K. (= *Tricholaena insularis* (L.) Grieseb., = *Trichachne insularis* (L.) Nees, = *Digitaria insularis* (L.) Fedde), Argentina, **4**. *Ustilago delicata* L. Ling (as "*delicatus*"), type on "*Tricholaena delicatula* Stapf & C. E. Hubb.", Congo (for comments see below), **5**. *Ustilago trichophora* (Link) Körn., type on *Echinochloa colonum* (L.) Link, Egypt (n. v.), and **6**. *Ustilago argentina* Speg., type on *"Tricholaena insularis"* (L.) Grieseb. (= misnamed *Panicum urvilleanum* Kunth), Argentina.

Of these, only *Sporisorium tricholaenae* is parasitising *Tricholaena*, and it is questionable if *Ustilago trichophora* is occuring also on this grass genus.

An additional smut fungus was recently collected in Zimbabwe.

Sporisorium monachnes K. & C. Vánky, **sp. nov.**

Typus in matrice *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb. (det. S. Katiwu), Zimbabwe, Manicaland Prov., cca. 70 km S. urbe Mutare, 19°31'01" S, 32°34'41" E, alt. cca. 730 m.s.m., 26.II.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18877!, isotypi in BPI, IMI 380466 et in S.

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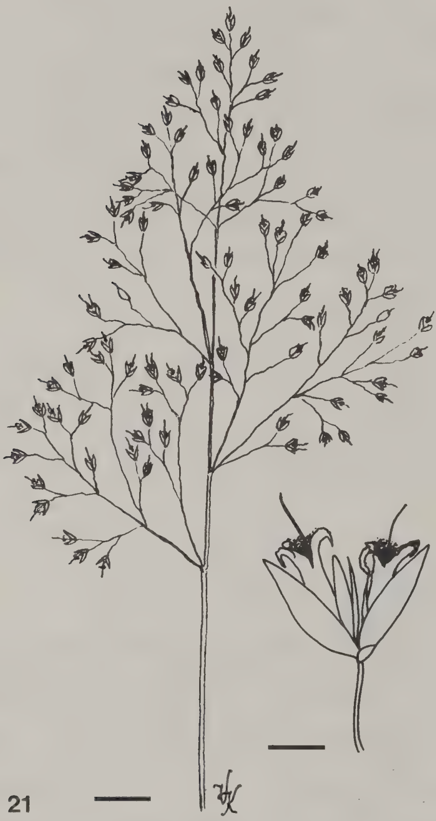


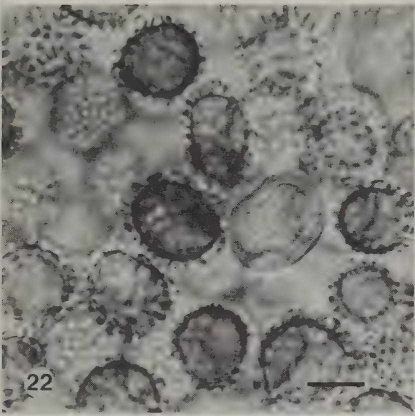
Fig. 21. Sori of *Sporisorium monachnes* K. & C. Vánky on *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb. Enlarged a spikelet with both florets infected (type).

Bars = 1 cm (left) and 1 mm (right).

Figs. 22, 23. Spores and sterile cells of *Tilletia sporoboli* K. Vánky on *Sporobolus festivus* A. Rich., in LM and in SEM (type). Bars = 10 µm.

Figs. 24, 25. Spore balls and spores of *Sporisorium monachnes* K. & C. Vánky on *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb., in LM and in SEM (type). Bars = 10 µm.

Figs. 26, 27. Spores and sterile cells of *Macalpinomyces simplex* K. Vánky on *Loudetia simplex* (Nees) C. E. Hubb., in LM and in SEM (type). Bars = 10 µm.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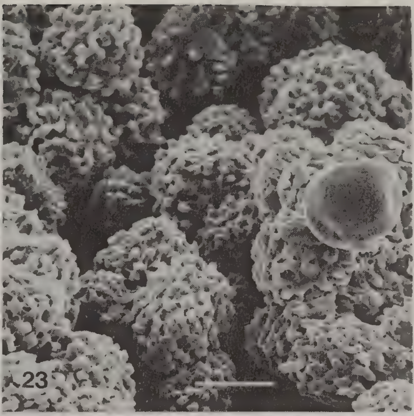
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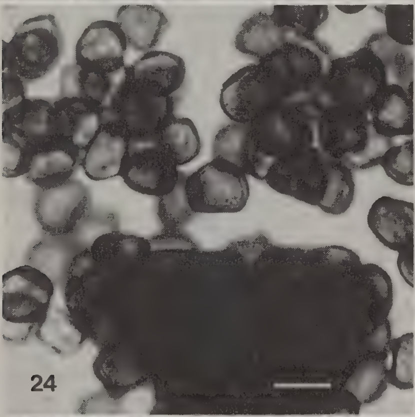
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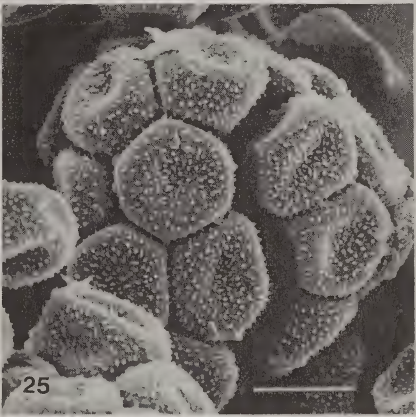
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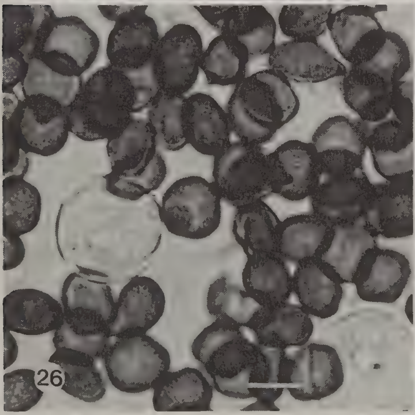
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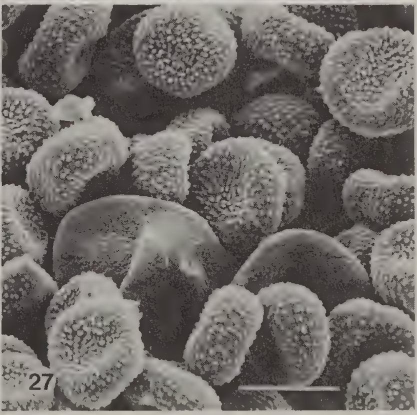
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Sori in flosculis, duo in quaque spicula, inconspicui, post involucra floralia amplectentia parum protrusi, breviter cylindrici, cca. 0,5 x 2 mm, primo peridio albido usque pallide flavidobrunneo cooperti, quo rupto ab apice eius massam atrobrunneam, pulveream glomerulorum sporarum et sporarum, columellam brevem, centralem, attenuentem circumdantium ostendentes. *Glomeruli sporarum* globosi usque ellipsoidales, 25–50 x 30–55 µm, rufobrunnei, e sporis 15–50?, facile separabilibus compositi. *Sporae* subpolyedriter irregulares, 8–10,5 x 9,5–13 µm, rufobrunneae; pariete parum irregulari, cca. 1 µm crasso, leniter, dense verruculoso-echinulato in surficie libera ex obliquo subtiliter serrulato apparenti; sporae internae aliquantulum minores, colore pallidiores; pariete tenui (cca. 0,5 µm), subtiliter punctato.

Sori (Fig. 21) in the florets, two in each spikelet, inconspicuous, slightly protruding behind the clasping floral envelopes, short cylindrical, c. 0.5 x 2 mm, first covered by a whitish to pale yellowish-brown peridium which ruptures from its apex disclosing the dark brown, powdery mass of spore balls and spores surrounding a short, tapering central columella. *Spore balls* (Figs. 24, 25) globose to ellipsoidal, 25–50 x 30–55 µm, reddish-brown, composed of 15–50? easily separating spores. *Spores* (Figs. 24, 25) subpolyhedrally irregular, 8–10.5 x 9.5–13 µm, reddish-brown; wall slightly irregular, c. 1 µm thick, finely, densely verruculose-echinulate on the free surface which appears finely serrulate in median view; inner spores somewhat smaller, lighter coloured; wall thin (c. 0.5 µm), finely punctate.

On *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb., S. Africa (Zimbabwe).

Ling (1953:153) described ***Ustilago delicata*** L. Ling (as "*delicatus*"), with type on *Tricholaena delicatula* Stapf & C. E. Hubb. (syn. *T. monachne* (Trin.) Stapf & C. E. Hubb., = misnamed *T. congoensis* Franch., syn. *Melinis nerviglumis* (Franch.) Zizka), Rep. Congo, Gungu Prov., Nyungu, 05°42' S, 19°22' E, I.1914, H. Vanderyst 3230, BR 1313! (as "*Ustilago tricholaena* Henn. var. *congoensis* Beeli", nom. herb.). Paratype on *T. delicatula* (= misnamed *Rhynchelytrum nerviglume* (Franch.) Chiov., syn. *Melinis repens* (Willd.) Zizka), Rep. Congo, Gungu Prov., Taka, 05°54' S, 19°26' E, I.1914, H. Vanderyst 3382, BR 1314!

Judged from the original description, *U. delicata* could be a *Sporisorium*. However, the study of the type specimens did not conform this.

Key to the smut fungi of *Tricholaena*.

1. Sori in some of the spikelets, on the leaves and stems forming up to several cm long swellings. Spores 7–12 µm long, moderately sparsely punctate-tuberculate or echinulate .... *Ustilago trichophora*(?)
– Sori in all spikelets of an inflorescence, smaller. Spores finely verruculose-echinulate 2
2. Sori 1.5–5 mm long. Spores 7–10 µm long. On *T. teneriffae*............................ .... *Sporisorium tricholaenae*
– Sori up to 2 mm long. Spores 9.5–13 µm long. On *T. monachne* .... *Sporisorium monachnes*

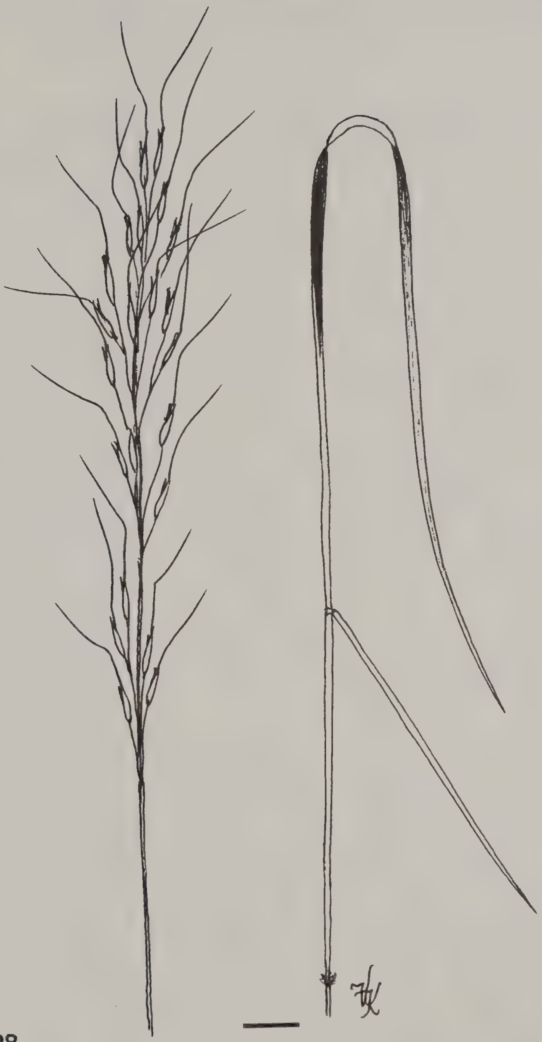

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Fig. 28. Sori of *Macalpinomyces simplex* K. Vánky in the distal part of the culm of *Loudetia simplex* (Nees) C. E. Hubb. (type). To the left a healthy panicle. Bar = 1 cm.

A NEWS SPECIES OF *MACALPINOMYCES* ON *LOUDETIA* (GRAMINEAE)

A *Macalpinomyces* species on *Loudetia simplex*, collected recently in Zimbabwe, turned out to be different from *M. ludetiae* on *L. arundinacea* and *L. flavida* and also from all known *Macalpinomyces* species. It is described as:

Macalpinomyces simplex K. Vánky, **sp. nov.**

Typus in matrice *Loudetia simplex* (Nees) C. E. Hubb., Zimbabwe, Manicaland Prov., 31 km S.S.E. Nyanga, "Scenic Route", 18°25'09" S, 32°45'56" E, alt. cca. 1750 m.s.m., 21.II.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18901!, isotypi in BPI et in Vánky, Ust. exs. No. 1064 (ineditus). Paratypus in matrice *Loudetia simplex*, Zimbabwe, Manicaland Prov., 85 km N. urbe Mutare, Nyanga National Park, Nyamziwa Falls, 18°15'11" S, 32°47'30" E, alt. cca. 1910 m.s.m., 22.II.1999, leg. C. & K. Vánky, HUV 18902!

Sori in parte distali culmi, eam in tubam tenuem, longam, acutam, ex telis hostalibus atque hyphis sporogenicis productam transformantes. Tubae massa sporarum atrobrunnea, agglutinata usque semipulverea, cellulis sterilibus intermixta impletae. Sori in statu juvenili virides, maturitate elongati, a parte distali longitudinaliter disrupti, post dispersionem sporarum autem in ligamentum pallide albido- vel flavido-brunneum, flexuosum, 1–2 mm latum, usque ad 30 cm longum transformati. Caules infecti steriles. *Sporae* forma et magnitudine satis varias, subglobosae, ellipsoidales, ovoideae, pyriformes, saepe acuminatae, nonnunquam curvatae, 7–11(–12) x 9,5–15 µm, mediocriter olivaceobrunneae; pariete aequaliter usque inaequaliter crasso, cca. 0,8 µm crassitudine sed ad apices sporarum acutarum usque ad 2 µm crasso, conspicue, uniformiter, humiliter verrucoso exceptis apicibus levibus; sporae ex obliquo subtiliter undosae. *Cellulae steriles* magnae, globosae, late ellipsoidales usque parum irregulares, 13–27 x 15–29 µm, singulae vel raro geminae, hyalinae usque subhyalinae, cum aliquot guttulis olei; pariete aequaliter crasso, 1–2 µm, levi.

Sori (Fig. 28) in the distal part of the culm transforming it into a narrow, long, acute tube formed of host tissues and sporogenous hyphae. The tubes are filled with a blackish-brown, agglutinated to semipowdery mass of spores intermixed with sterile cells. Young sori are green. At maturity they elongate, split longitudinally from their distal part, the spores are scattered and the sori are transformed into pale whitish- or yellowish-brown, 0twisted bands, 1–2 mm wide, up to 30 cm long. Infected shoots remain sterile. *Spores* (Figs. 26, 27) rather variable in shape and size, subglobose, ellipsoidal, ovoid, pyriform, often acuminate, sometimes curved, 7–11(–12) x 9.5–15 µm, medium olivaceous-brown; wall evenly to unevenly thick, c. 0.8 µm wide but at the tips of the acute spores up to 2 µm thick, evidently, uniformly, low verrucose except of the smooth tips, spore profile finely wavy. *Sterile cells* (Figs. 26, 27) large, globose, broadly ellipsoidal to slightly irregular, 13–27 x 15–29 µm, single or rarely in pairs, hyaline to subhyaline, with several oil droplets; wall evenly thick, 1–2 µm, smooth.

On *Loudetia simplex* (Nees) C. E. Hubb., S. Africa (Zimbabwe).

THREE NEW SMUT FUNGI ON *ANDROPOGON* (GRAMINEAE)

It is not easy to identify smut fungi of *Andropogon*. This is not only because of the many (over 80) described smut fungi on this genus which numbers over 100 species, but also because the generic position of many of these host plants is not stable. Zundel (1930) published his "Monographic studies on the Ustilaginales attacking *Andropogon*". Despite the old generic conceptions, this paper is an excellent monograph with keys to 76 species of smut fungi, their descriptions, host plant range and geographic distribution.

Recently, two smut fungi were collected in Zimbabwe on *Andropogon gayanus*, and a further one on *A. fastigiatus* which could not be identified with any earlier known smut fungus on *Andropogon*.

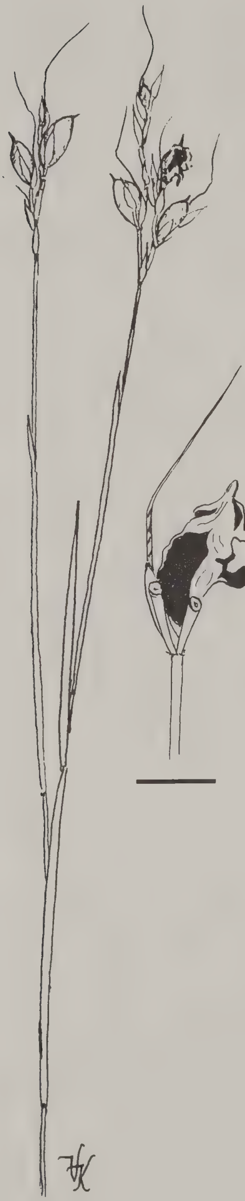
Sporisorium ovariicolopsis K. Vánky, **sp. nov.**

Typus in matrice *Andropogon gayanus* Kunth, Zimbabwe, Matabeleland North Prov., 12 km N. pag. Lusulu, 17°58'54" S, 27°50'09" E, alt. cca. 1010 m.s.m., 16.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18903!, isotypi in BPI, IMI 380467 et in S.

Sori in spiculis sessilibus, nonnullas tantum earum ejusdem inflorescentiae inficientes, intacte involucra floralia maxime externa relinquentes, limoniiformes vel obovoidei, apicibus acutis vel subacutis, 3–5 x 5–10 mm, peridio crasso, primo viride deinde brunneo, origine hostali et fungali, quo rupto aperto et irregulariter dehiscenti, massam agglutinatam semipulveream, atrobrunneam sporarum cum cellulis sterilibus intermixtam ostendentes. Sori sub ovariis crescere incipientes. Semina inevoluta in apice sorarum juvenilium sicut acumina acuta forte permanentes. *Sporae* maturae singulae, subglobosae, ovoideae vel ellipsoidales, (5,5–)6,5–8(–9,5) x (6,5–)7–11 µm, flavidobrunneae; pariete aequali, 1–1,5 µm crasso, prominenter, satis dense echinulato. *Cellulae steriles* in catervis laxis irregularibus vel in catenis brevibus, cellulae singulae subglobosae, ovoideae vel irregulares, cum latere uno deplanato vel duobus lateribus deplanatis, 5–9 x 6–11(–14) µm, hyalinae; pariete tenui (cca. 0,5 µm), levi.

Sori (Fig. 29) in sessile spikelets, infecting only a few in the inflorescence, leaving intact the outermost floral envelopes, lemon-shaped or obovoid with acute or subacute tips, 3–5 x 5–10 mm, covered by a thick, first green later brown peridium of host and fungal origin which ruptures and opens irregularly disclosing the agglutinated to semipowdery, dark brown mass of spores intermixed with sterile cells. The sori start to develop beneath the ovaries. The undeveloped seeds may persist on the top of young sori as an acute tip. *Spores* (Figs. 32, 33) when mature single, subglobose, ovoid or ellipsoidal, (5.5–)6.5–8(–9.5) x (6.5–)7–11 µm, yellowish-brown; wall even, 1–1.5 µm thick, prominently, rather densely echinulate. *Sterile cells* (Figs. 32, 33) in loose, irregular groups or in short rows, single cells subglobose, ovoid or irregular, with one or two flattened sides, 5–9 x 6–11(–14) µm, hyaline; wall thin (c. 0.5 µm), smooth.

On *Andropogon gayanus* Kunth, S. Africa (Zimbabwe).



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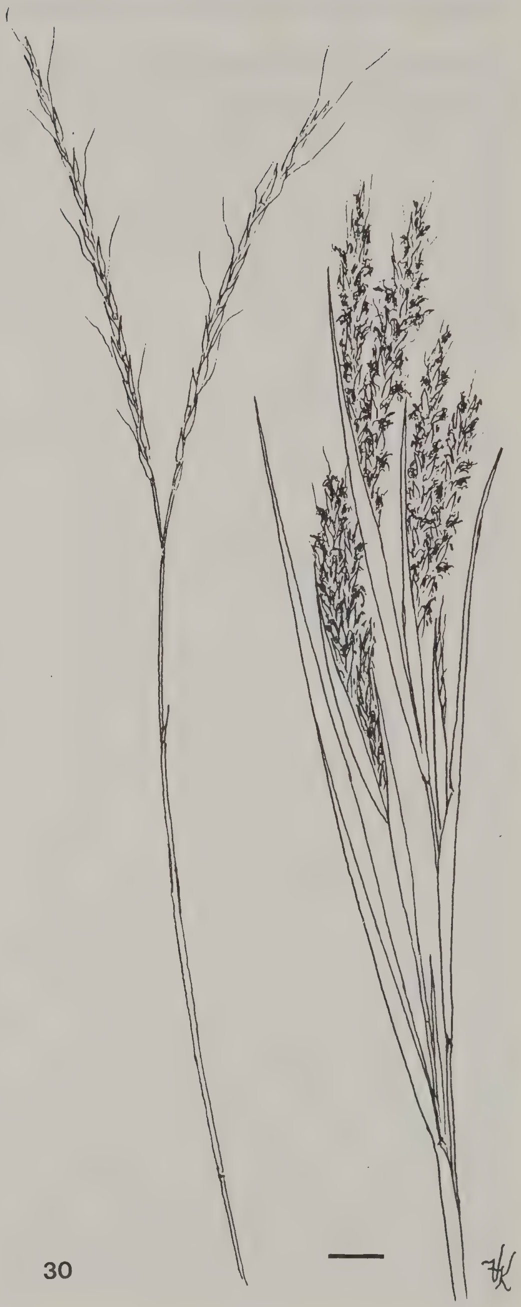

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Etymology: *ovari*- from the Latin ovarium (= ovary), *col*- from the Latin colere (= to inhabit), *opsis* Greek (= appearance), because the sori seem to be developed in the ovaries, which is not the case.

Sporisorium gayanum K. & C. Vánky, **sp. nov.**

Typus in matrice *Andropogon gayanus* Kunth, Zimbabwe, Matabeleland North Prov., 12 km N. pag. Lusulu, 17°58'54" S, 27°50'09" E, alt. cca. 1010 m.s.m., 16.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18899!, isotypi in BPI, IMI 380465, S et in Vánky, Ust. exs. No. 1065 (ineditus).

Sori in spiculis omnibus, tam sessilibus quam pedicellatis inflorescentiae, involucra maxime externa floralia tantum, raro antheras etiam nonnullas intacte relinquentes, cylindracei, apice acuti, cca. 1 x 5–10 mm, peridio pallide flavidobrunneo cooperti, quo ab apice ejus mature rupto et torto, massam atrobrunneam, primo agglutinatam, serius granuloso-pulveream glomerulorum sporarum et columallas nonnullas (3–6) filiformes ostendentes. Peridium in statu juvenili saepe residua organorum internorum floralium vel antheras abortivas gerens. *Glomeruli sporarum* forma magnitudineque varii, late ellipsoidales, ovoidei, elongati vel irregulares, 35–90 x 40–120(–140) µm, rufobrunnei usque opaci, permanentes e sporis pluries decem usque centum unum arcte contiguis formati. *Sporae* dimorphae, i.e., sporae externae et internae differentes: sporae externae subpolyedrice irregulares, 8–12 x 10,5–14,5 µm, atro-rufobrunneae; pariete parum inequali, 1–2 µm crasso, superficie libera prominenter verruculoso-echinulata, visu mediano leniter serrulata apparenti; sporae internae subpolyedrice vel polyedrice irregulares, saepe elongatae, arcte contiguae, magnitudine sporis externis aequales vel parum minores, subhyalinae vel pallide flavidobrunneae; pariete tenui (cca. 0,5 µm), aequali, levi. *Cellulae steriles* paucae, in catervis parvis dispositae vel catenulatae; cellulae singulae subglobosae, elongatae vel irregulares, lateribus deplanatae, 5–13 µm longae, hyalinae; pariete tanui (cca. 0,5 µm), levi.

Sori (Fig. 30) in all sessile and pedicelled spikelets of the inflorescence, leaving intact only the outermost floral envelopes, rarely also a few anthers, cylindrical with acute tip, c. 1 x 5–10 mm, covered by a pale yellowish-brown peridium which ruptures early from its apex and curls disclosing the blackish-

Fig. 29. Sori of *Sporisorium ovariicolopsis* K. Vánky in a few sessile spikelets of an inflorescence of *Andropogon gayanus* Kunth. Enlarged an older, opened sorus with remnants of the seed on its top (type).
Bars = 1 cm (beneath) and 6 mm (for the detail picture).

Fig. 30. Sori of *Sporisorium gayanum* K. & C. Vánky in all spikelets of the inflorescence of *Andropogon gayanus* Kunth (type). To the left a healthy inflorescence. Bar = 1 cm.

brown, first agglutinated, later granular-powdery mass of spore balls and 3–6 filiform columellae. In young stage, the peridium often bears remnants of inner floral organs or aborted anthers. *Spore balls* (Figs. 34, 35) variable in shape and size, broadly ellipsoidal, ovoid, elongate or irregular, 35–90 x 40–120(–140) µm, reddish-brown to opaque, permanent, composed of tens to a hundred tightly packed spores. *Spores* (Figs. 34, 35) dimorphic, i.e., outer and inner spores of a ball are different; outer spores subpolyhedrally irregular, 8–12 x 10.5–14.5 µm, dark reddish-brown with slightly unevenly, 1–2 µm thick wall, prominently verruculose-echinulate on the free surface which appears finely serrulate in median view; inner spores subpolyhedrally or polyhedrally irregular, often elongated, tightly packed, the size of the outer spores or somewhat smaller, subhyaline or pale yellowish-brown; wall thin (c. 0.5 µm), even, smooth. *Sterile cells* (Figs. 34, 35) few, in small groups or chains; single cells subglobose, elongated or irregular, with flattened sides, 5–13 µm long, hyaline; wall thin (c. 0.5 µm), smooth.

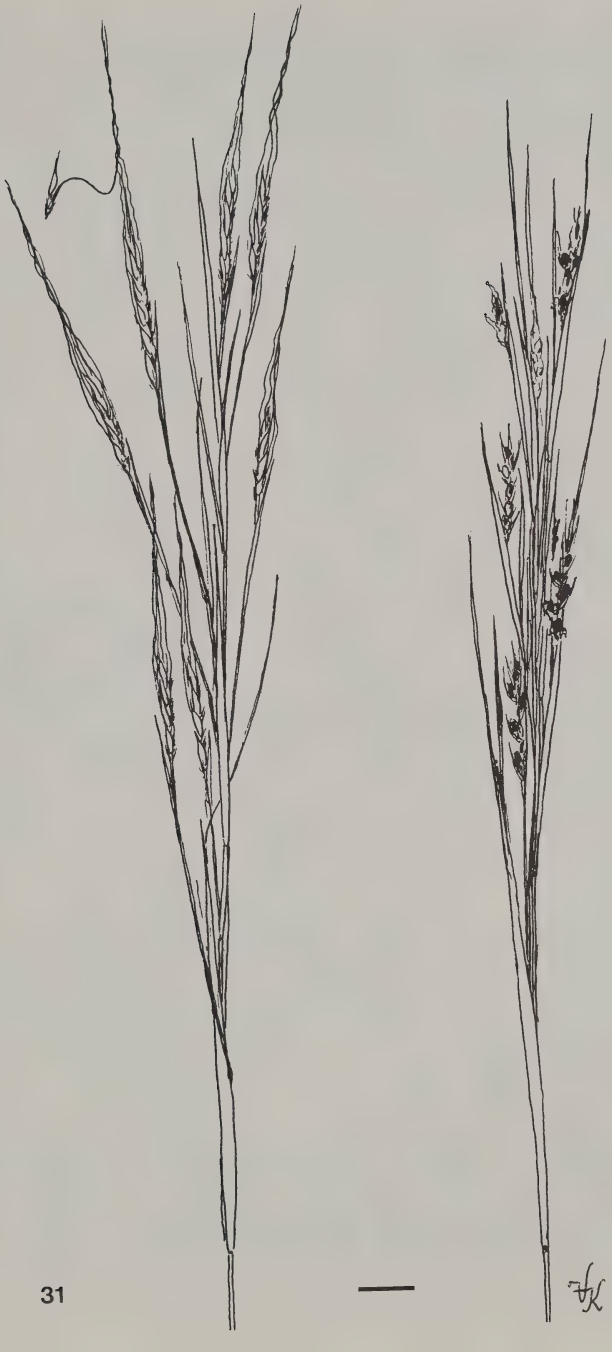
On *Andropogon gayanus* Kunth, S. Africa (Zimbabwe).

Sporisorium fastigiatum K. Vánky, **sp. nov.**

Typus in matrice *Andropogon fastigiatus* Swartz (*Diectomis fastigiata* (Swartz) Kunth), Zimbabwe, Matabeleland North Prov., 25 km S.E. oppid. Binga, 17°48'09" S, 27°25'04" E, alt. cca. 690 m.s.m., 15.III.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18910!, isotypi in BPI et in Vánky, Ust. exs. No. 1066 (ineditus). Paratypus in matrice *Andropogon fastigiatus*, Matabeleland North Prov., cca. 50 km N.W. pag. Lusulu, alt. cca. 970 m.s.m., 16.III.1999, leg. C. & K. Vánky, HUV 18911!

Sori in spiculis omnibus sessilibus item pedicellatis eiusdem inflorescentiaee, eas omnio destruentes, ovoidei, 1–2 x 2–4 mm, primo peridio crasso, flavidobrunneo cooperti, residua involucrorum floralium gerentes. Maturitate peridio in partes nonnullas rupto massa semiagglutinata, atrobrunnea sporarum et cellulae steriles columellam compactam, centralem, plerumque ramulis brevibus lateralibus instructam circumdantes patefactae. Raro sori inflorescentiam totam vel partem eius occupantes. *Sporae* juveniles in globulis laxis dispositae, maturitate singulae, subglobosae, ellipsoidales, plerumque rotundatae, subpolyedriter irregulares, 8–11 x 9–13,5 µm, rufobrunneae; pariete aequali vel parum inaequali, 0,5–0,8 µm crasso, conspicue levi usque leniter, dense punctato vel punctato-echinulato; sporae ex obliquo leves vel valde leniter serrulatae. *Cellulae steriles* in catervis compactis, rotundatis vel elongatis, 15–25 x 20–35 µm, forte catenas breves formantibus; cellulae singulae irregulares, subpolyedricae cum lateribus deplanatis, raro ovoideae, 5–13 µm longae, subhyalinae contentu homogineo; pariete 0,5–1 µm crasso, levi.

Fig. 31. Sori of *Sporisorium fastigiatum* K. Vánky in all spikelets of *Andropogon fastigiatus* Swartz (type). To the left a healthy inflorescence. Bar = 1 cm.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Sori (Fig. 31) in all sessile and pedicelled spikelets of the inflorescence, completely destroying them, ovoid, 1–2 x 2–4 mm, first covered by a thick, pale yellowish-brown peridium which bears remnants of floral envelopes. At maturity, the peridium ruptures in several places disclosing the semiagglutinated, blackish-brown mass of spores and sterile cells surrounding a stout, central columella, usually with short lateral branches. Rarely, the sori may comprise the whole inflorescence or a part of it. *Spores* (Figs. 36, 37) when young in irregular, loose balls, when mature single, subglobose, ellipsoidal, usually rounded, subpolyhedrally irregular, 8–11 x 9–13.5 µm, reddish-brown; wall even or slightly uneven, 0.5–0.8 µm thick, apparently smooth to finely, densely punctate or punctate-echinulate, spore profile smooth to very finely serrulate. *Sterile cells* (Figs. 36, 37) in compact, rounded or elongated groups, 15–25 x 20–35 µm, these may be agglutinated in short chains; single cells irregular, subpolyhedral with flattened sides, rarely ovoid, 5–13 µm long, subhyaline with homogenous content; wall 0.5–1 µm thick, smooth.

On *Andropogon fastigiatus* Swartz. Known from the type collections only.

NEW COMBINATION

Sporisorium cordobense (Speg.) K. Vánky, **comb. nov.**

Basionym: *Ustilago cordobensis* Spegazzini, Anales Soc. Ci. Argent. 12:64, 1881. — *Sphacelotheca cordobensis* (Speg.) H. S. Jackson, 1930:298. — *S. cordobensis* (Speg.) Ciferri, 1931:16 (later homonym). — Type on "*Panicum jaboncillo*" Hieron., nom. nud. (= *P. leucophaeum* H. B. K., = *Trichachne insularis* (L.) Nees, = *Digitaria insularis* (L.) Fedde; comp. Spegazzini, 1909:288), Argentina, near Cordoba, leg. Hieronymus.

Ustilago cacheutensis Spegazzini, 1909:293. — Type on *Panicum leucophaeum* H. B. K. (= *Digitaria insularis* (L.) Fedde), Argentina, near Mendoza, Cacheuta, I.1909, C. Spegazzini (comp. Spegazzini, 1925:153).

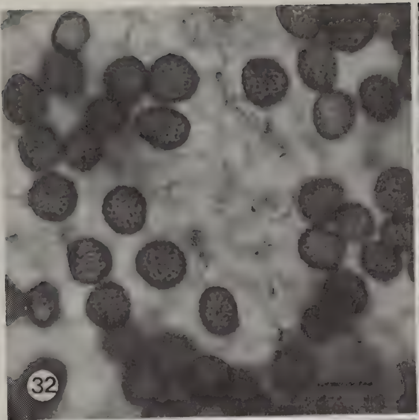
For description see Zundel, 1953:86 (sub *Sphacelotheca cordobensis*).

Ling, 1951:103, considered *Sphacelotheca viegasiana* Zundel, 1939:588 (type on *Trichachne sacchariflora* (Raddi) Nees, = *Digitaria insularis* (L.) Fedde, Brazil), to be a synonym of *Sphacelotheca cordobensis*. However, this must be verified. According to the original description, *S. viegasiana* seems to be closer, if not identical, with *Sporisorium panici-leucophaei* (Bref.) M. Piepenbr.

Figs. 32, 33. Spores and sterile cells of *Sporisorium ovariicolopsis* K. Vánky on *Andropogon gayanus* Kunth, in LM and in SEM (type). Bars = 10 µm.

Figs. 34, 35. Spore balls (more or less disintegrated), and spores of *Sporisorium gayanum* K. & C. Vánky on *Andropogon gayanus* Kunth, in LM and in SEM (type). Bars = 10 µm.

Figs. 36, 37. Spores and sterile cells of *Sporisorium fastigiatum* K. Vánky on *Andropogon fastigiatus* Swartz, in LM and in SEM (type). Bars = 10 µm.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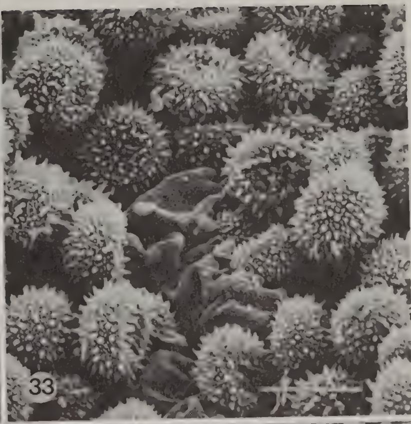
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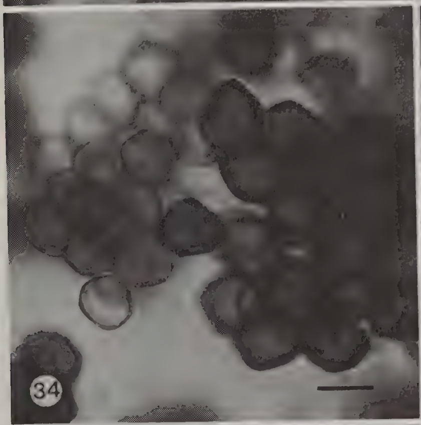
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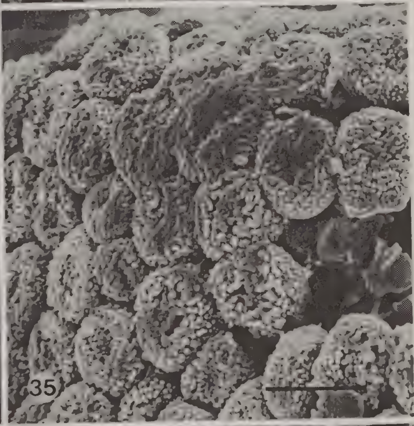
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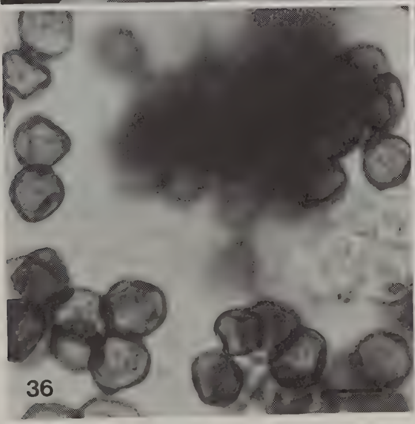
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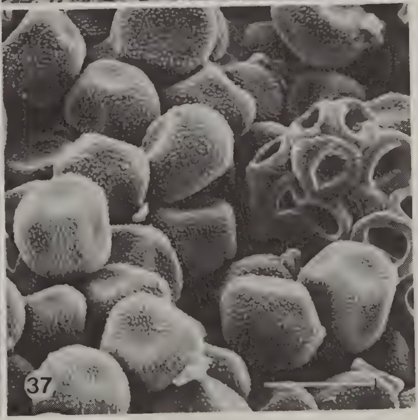
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A NEW SPECIES OF *ENTYLOMA* ON *ARCTOTIS* (COMPOSITAE)

Entyloma arctotis K. Vánky, **sp. nov.**

Typus in matrice *Arctotis lawsoniana* (Gaudich.) Beauverd (*Cymbonotus lawsonianus* Gaudich.), Australia, New South Wales, Oberon District, 26.I.1953, leg. L. Fraser. Holotypus in BRIP 7990!, isotypus in HUV 18635!

Sori in foliis sicut maculae circulares, brunneae, parum tumefactae, 1–3(–4) mm diametro, evidentes ad superficiem adaxialem (latus abaxiale foliorum pilis albis dense cooperti). *Sporae* globosae, ellipsoidales usque subpolyedriter irregulares cum lateribus contactis deplanatis, 9–13 x 10–16 µm, pallide flavido-brunneae; pariete bistratoso, parum inaequali, ad angulos crassisimo, 1,5–3(–3,5) µm crasso, levi.

Sori (Fig. 38) in the leaves as circular, brown, slightly swollen spots, 1–3(–4) mm in diameter, evident on the adaxial surface (the abaxial side of the leaves is densely covered with white hairs). *Spores* (Fig. 39) globose, ellipsoidal to subpolyhedrally irregular with flattened contact sides, 9–13 x 10–16 µm, pale yellowish-brown; wall two-layered, slightly uneven, thickest at the angles, 1.5–3(–3.5) µm thick, smooth.

On *Arctotis lawsoniana* (Gaudich.) Beauverd (*Cymbonotus lawsonianus* Gaudich.), Australia. Known only from the type collection.

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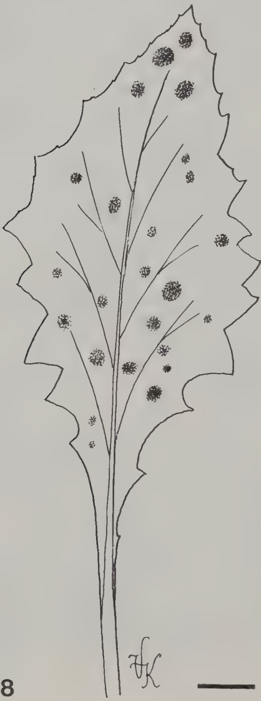

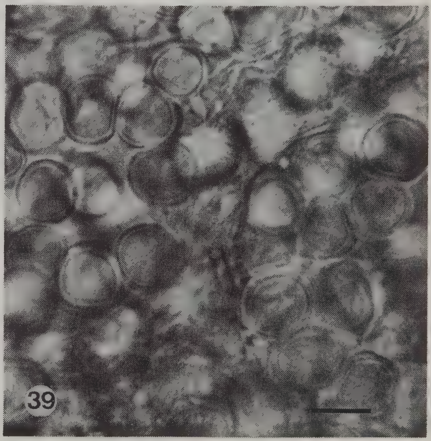

Entyloma arctotis K. Vánky on *Arctotis lawsoniana* (Gaudich.) Beauverd (type).

Fig. 38. Sori on a leaf as slightly swollen, brown, rounded spots of a few mm in diameter. Bar = 1 cm.

Fig. 39. Spores in LM. Bar = 10 µm.

***Sporisorium penniseti*, history, neotype, synonyms.**
Rabenhorst (1871:18) described *Ustilago penniseti* Rbh., giving the following brief description: "sporis globosis, glabris, brunneis, diam. 0,009–0,011 millim. An *Pennisetum fasciculatum* Trin. auf Kalkfelsen bei der Brücke Dschihau-Körpi, bei Marasch." In the introduction, Rabenhorst (1871:17) wrote that the cryptogams published in his paper were collected by Professor C. Haussknecht during his trips to the Orient and especially to Persia, between 1864-1865 and 1866-1868. Apparently, the type specimen of *U. penniseti* no longer exists. However, in Herbarium Haussknecht in Jena (JE) there is a collection of *U. penniseti* on "*Pennisetum orientale* Rich. (*P. fasciculatum* Trin.)", collected by C. Haussknecht in "Taurus Catasnicus, 1865". This specimen agrees with the short description of *U. penniseti* with the exception that the spores are not smooth but punctate to finely and densely echinulate. This fine ornamentation was certainly beyond Rabenhorst's 1871 limit of microscopic resolution (Vánky, 1989:155). Consequently, I would like to designate the above-mentioned collection in JE as the neotype of *Ustilago penniseti* Rbh. The name *U. penniseti* Rbh. was transferred into the genus *Sphacelotheca* by Reichert (1921:679), and into *Sporisorium* by Ershad (1994:18). Studying *Sorosporium catharticum* Maire, I wrote (Vánky, 1989:155): "Based on the description, *S. catharticum* could be conspecific with *Ustilago penniseti* Rbh. . . . . . . Rabenhorst (1871:18) described his species as being smooth-spored whereas spores of *S. catharticum* are pitted to finely echinulate. . . . . . . Reexamination of the type material of *U. penniseti* is necessary to resolve this problem". Comparison of the type specimens of *S. catharticum* Maire, *S. penniseti* Mundkur, and *Ustilago penniseti* Rbh. var. *verruculosa* Massenot, with the neotype of *U. penniseti* Rbh., did not reveal any essential differences to justify keeping them as separate species or a variety. The following synonymy is proposed:

Sporisorium penniseti (Rbh.) Ershad, 1994:18.

Ustilago penniseti Rabenhorst, 1871:18. — *Sphacelotheca penniseti* (Rbh.) Reichert, 1921:679. — Neotype on *Pennisetum fasciculatum* Trin. (= *P. orientale* L. C. Rich.; designated here), "Taurus Catasnicus", 1865, C. Haussknecht, JE!

Sorosporium catharticum Maire, 1931:359. — *Sporisorium catharticum* (Maire) K. Vánky, 1989:155. — Type on *Cenchrus catharticus* Delile (= *C. biflorus* Roxb.), Algeria, South Sahara, near Tilemsi, coll. T. Monod 467, MPU!

Sorosporium penniseti Mundkur, 1939:116. — Type on *Pennisetum ciliare* (L.) Link (= *Cenchrus ciliaris* L.), India, Delhi, Ridge, 3.VIII.1938, coll. Azmatulla Khan, HCIO 7749!

Ustilago (*Sphacelotheca*) *penniseti* Rbh. var. *verruculosa* Massenot, in Guyot et al., 1969:217. — Type on *Pennisetum ciliare* (L.) Link, Morocco, near Atchana, Valley of Oued Guir, 12.VI.1932, G. Malençon 140, PC!

For description and illustration see Vánky, 1994:199 & 210 (as *Sporisorium catharticum*).

EXCLUDED SPECIES

Ustilago globulifera is a *Ustilaginoidea*

Ustilago globulifera Saccardo & Trotter, in Bresadola & Saccardo, 1899:159 + Pl. C, fig. 1. — Type on Andropogoneae? (= *Trichopteryx* cf. *hordeiformis* Stapf, det. A. S. Hitchcock, = *Loudetia hordeiformis* (Stapf) C. E. Hubb.), Congo, without date and locality, coll. A. Dewèvre 60, BR, BPI 160501!, 160502!

Zundel noted on the labels in BPI that this fungus is "*Ustilaginoidea globulifera* (Sacc. & Trotter) Zundel", without publishing it. Study of the two isotypes confirmed that this fungus is a *Ustilaginoidea* (Fungi Imperfecti).

ACKNOWLEDGEMENTS

I am grateful to Dr. S. Tóth (Gödöllő, Hungary) for providing the Latin descriptions, to Dr. E. H. C. McKenzie (Auckland, New Zealand), and to Dr. R. Berndt (Tübingen, Germany) for reading the manuscript and serving as pre-submission reviewers, and to Dr. W. Gams (Baarn, Netherlands) and Dr. M. Weiß (Tübingen, Germany) for nomenclatorial, respectively Latin terminological advices. The isotypes of *Sorosporium sehimae* and *S. sulcati* are kindly acknowledged to their author, Prof. M. S. Patil (Kolhapur, India), and the isotype of *Sphacelotheca pakistanica* (= *Sporisorium andropogonis–micranthi*) to Dr. S. Ahmad (Samanabad, Lahore, Pakistan). Thanks are also due to the Directors and Curators of the Herbaria BPI, BR, BRIP, FH, FT, HCIO, IMI, JE, MPU and PC for loans and/or exchange of specimens.

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MYCOTAXON

Volume LXXIV(1), pp. 217-239 January-March 2000

COMPUTER AIDED SYSTEMATIC EVALUATION OF MORPHOLOGICAL CHARACTERS OF THE OPHIOSTOMATOID FUNGI

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ABSTRACT

Ceratocystis sensu lato includes over 100 species that are accommodated in three genera, *Ceratocystis sensu stricto*, *Ceratocystiopsis* and *Ophiostoma*. In the taxonomic history of these fungi, many different characters have been emphasised, including ascospore morphology, presence or absence of ascospore sheaths, anamorphs, conidium ontogeny, and others. These characters have often been applied inconsistently. For example, species with falcate ascospores were assigned to *Ceratocystiopsis*, while other groups of species having different ascospore forms were not given similar status. The advent of computer aided systematics has made it possible to analyse morphological characters objectively and to determine their influence on classification systems. Unfortunately, computer characters do not lend themselves to describe variation in morphological characters. Information is thus lost in the process of translating morphological characters into computer character states. This study describes a process of using binary code to describe morphological characters in terms of multi-state characters. This system allows for the inclusion of natural variation in computer aided parsimony. Furthermore, characters can be weighted equally, selectively or deleted to determine their effect on the taxonomic position of species being considered. Using this approach to code characters, species of *Ceratocystis sensu lato* were analysed using the parsimony analysis package PAUP. Morphologically, *Ceratocystis sensu stricto* forms a distinct monophyletic group to *Ophiostoma* and *Ceratocystiopsis*. Species of *Ceratocystiopsis* cluster with species of *Ophiostoma*. Results indicate that anamorph characters are important in distinguishing different groups in *Ceratocystis sensu lato*.

KEYWORDS: *Ophiostoma*, *Ceratocystis*, *Ceratocystiopsis*, morphology, character coding, phylogeny, computer systematics.

INTRODUCTION

Ceratocystis sensu lato (*s.l.*) (Upadhyay, 1981) includes over 100 species that are presently accommodated in three genera, *Ceratocystis sensu stricto* (*s.s.*) Ellis & Halst., *Ceratocystiopsis* H.P. Upadhyay & W.B. Kendr. and *Ophiostoma* Syd. & P. Syd. (de Hoog and Scheffer, 1984; Wingfield *et al.*, 1993). Species in *Ceratocystis* have *Chalara* Corda anamorphs. *Ceratocystiopsis* spp. have several anamorph states including *Sporothrix* Hektoen & C.F. Perkins, *Hyalorhinocladiella* H.P. Upadhyay & W.B. Kendr. and *Chalara* (Upadhyay & Kendrick, 1975). Anamorphs of species of *Ophiostoma* are found in the genera, *Sporothrix*, *Hyalorhinocladiella*, *Leptographium* Lagerb. & Melin and *Graphium* Corda (Mouton *et al.*, 1994).

The Ophiostomatoid fungi produce morphologically similar ascomata but have many different ascospore forms (Olchowecki and Reid, 1974). Griffin (1968) thus subdivided *Ceratocystis s.l.*, based on ascospore form and the presence or absence of sheaths around these spores. Upadhyay and Kendrick (1975) argued that species of *Ceratocystis s.l.* with sheathed, elongate to falcate ascospores were distinct and established the genus *Ceratocystiopsis* for these taxa. Ultrastructural studies have shown that sheaths represent secondary layers (Van Wyk *et al.*, 1993) which are the remains of the perithecial cavity during ascospore development (Van Wyk *et al.*, 1991). Therefore, the taxonomic distinction of genera in *Ceratocystis s.l.* based on sheathed and unsheathed ascospore morphology in *Ceratocystis s.l.* is of dubious value.

Upadhyay (1981) distributed species remaining in *Ceratocystis* into four sections based on ascospore morphology. Section **Ceratocystis** (Type *C. fimbriata* Ellis & Halst.) included species with hat, half-moon or cucullate-shaped sheaths; section **Ophiostoma** (Type *O. piliferum* (Fr.) Syd. & P. Syd.) to accommodate species without sheaths; section **Ips** (Type *C. ips* (Rumbold) Nannf.) was established to accommodate species with pillow-shaped sheaths; section **Endoconidiophora** (Type *C. coerulescens*, (Münch) B.K. Bakshi) accommodating species with elongate or inequilateral sheaths. The sections **Endoconidiophora** and **Ceratocystis** comprised the **Fimbriata** group, previously established by Olchowecki and Reid (1974). After having previously established *Ceratocystiopsis*, based on ascospore form, it is surprising that Upadhyay (1981) established these sections rather than assigning them generic status.

Despite the presence of different anamorphs in *Ceratocystis s.l.*, their application in the taxonomy of these fungi has been controversial. Upadhyay and Kendrick (1975) and Upadhyay (1981) recognised several anamorph genera in *Ceratocystis s.l.* These included, *Chalara* (Nag Raj and Kendrick, 1993); *Leptographium*-like (*Verticicladiella* Hughes, *Phialocephala* W.B. Kendr.) (Wingfield, 1985; Wingfield, 1993); *Graphium*-like (*Phialographium* H.P. Upadhyay & W.B. Kendr., *Graphilbum* H.P. Upadhyay & W.B. Kendr., *Hyalopesotum* H.P. Upadhyay & W.B. Kendr., *Pachnodium* H.P. Upadhyay & W.B. Kendr., *Pesotum* Crane & Schokn., *Graphiocladiella* H.P. Upadhyay) (Seifert and Okada, 1993); *Sporothrix*-like (*Hyalodendron* Diddens); and *Hyalorhinocladiella* H.P. Upadhyay & W.B. Kendr.) (de Hoog, 1993). *Graphium* is considered the synnematous analogue of *Leptographium* (Upadhyay, 1981; Wingfield, 1993), while *Sporothrix* and *Hylorhinocladiella* are similar to each other differing only in the presence or absence of conidiogenous denticles (de Hoog, 1993). Conidia develop in the *Chalara* anamorphs of *Ceratocystis* and *Ceratocystiopsis* enteroblastically by ring-wall building, while conidia in the anamorph genera of *Ophiostoma* are produced holoblastically by apical-wall building (with the exception of *Cp. falcata*) (Minter *et al.*, 1982; 1983). Based on conidium ontogeny, *Cp. falcata* should reside in *Ceratocystis*. This species is taxonomically placed in *Ceratocystiopsis* due to its falcate sheathed ascospores. Recent studies using molecular data have shown that *Cp. falcata* is not phylogenetically related to species of *Ceratocystiopsis* (Hausner *et al.*, 1993).

Weijman and de Hoog (1975) argued for the separation of *Ceratocystis* and *Ophiostoma* due to the respective absence or presence of rhamnose and cellulose in their cell walls. Species of *Ceratocystis* lack rhamnose and cellulose in their cell walls. Furthermore, species of *Ceratocystis s.s.* are sensitive to low concentrations of the antibiotic cycloheximide. This is in contrast to the tolerance exhibited by species of *Ophiostoma* (Harrington, 1981; de Hoog and Scheffer, 1984).

Using molecular techniques such as ribosomal DNA sequencing, it has been possible to determine that *Ceratocystis* and *Ophiostoma* are phylogenetically distinct (Spatafora and Blackwell, 1993). Based on partial sequences of the small subunit ribosomal RNA gene it appears that *Ceratocystis* is phylogenetically best accommodated in the Microascales and *Ophiostoma* in Diaporthiales (Berbee and Taylor, 1992a, 1992b; Spatafora and Blackwell, 1993). Hausner *et al.* (1993) found that species of *Ophiostoma* and *Ceratocystiopsis* (with the exception of *Cp. proteae* M.J. Wingf. & P.S. van Wyk = *Gondwanamyces proteae* Marais & M.J. Wingf. and *Cp. falcata* (E.F. Wright & Cain) H.P. Upadhyay appear to form a monophyletic group, although a great degree of genetic diversity was found within this genus.

Three genera are currently accepted in the broader group of Ophiostomatoid fungi. These include: (1) *Ceratocystis*, with type species *C. fimbriata*; (2) *Ceratocystiopsis*, with type species *Cp. minuta* (Siem.) H.P. Upadhyay & W.B. Kendr.; and (3) *Ophiostoma*, and type species *O. piliferum*. There is a logical separation of species of *Ceratocystis* from species of *Ceratocystiopsis* and *Ophiostoma* based on conidium ontogeny. However, the distinction between *Ceratocystiopsis* and *Ophiostoma* is less clear, with species in these genera sharing various characteristics.

One of the problems in morphological systematics relates to how homology is recognised (Lutzoni and Vilgalys, 1995). The problem arises due to the difficulty of character interpretation (Tehler, 1990). The only way to test observed character homology is to expose all possible homology statements simultaneously to parsimony analysis (Tehler, 1990). With the advent of computer systematics, it has become possible to analyse large numbers of characters simultaneously. This has overcome the first step in treating morphological characters objectively.

One of the greatest challenges in morphological systematics relates to the interpretation of characters. A morphological character must be described in terms of quantitative grades (for example, ascospore size ranges) or qualitative characters (for example, light brown, brown to black or black pigmented ascospores) (Tehler, 1990). A further problem is encountered in unintentionally weighting characters selectively in data sets. Using different numbers of character states for different morphological characters introduces biased weighting. Examples of this can be found in every recent study analysing morphological characters (Lutzoni and Vilgalys, 1995; McLaughlin *et al.*, 1995; Petrini, 1993; Tehler, 1990). For example, Tehler (1990) assigned seven characters and 17 character states to ascospore morphology while five characters and 10 character states were used for pycnidia and conidia. Due to the difference in the number of character states used to describe these characters, ascospore morphology will have greater weight in computer analysis. This may contribute to the incongruency encountered between morphological and molecular data sets.

"The objective for any systematist must be to present a phylogeny and classification with a minimum of "*ad hoc*" hypotheses. This is not accomplished by the partitioning of data." (Tehler, 1995). This sentiment reflects the ultimate aim of systematics, to simultaneously assess all data and derive holistic phylogenies. The term 'holistic phylogenies' is used to imply phylogenies that take all available characters (morphological and molecular) into consideration. However, this is not currently possible. Morphological data cannot currently be coded in such a way as to objectively reflect true morphology. What in reality is being compared is the taxonomist's perception of various characters. Using consensus trees for both morphological and molecular data is, we believe, the only way to realise a holistic approach to systematics (Lutzoni and Vilgalys, 1995; McLaughlin *et al.*, 1995; Nishida *et al.*, 1995; Tehler, 1995). This will only be truly possible when morphology and molecular characters can be treated at the same level without *a priori* weighting.

In this study, we make use of computer aided systematics to evaluate the various morphological characters used in the taxonomy of the Ophiostomatoid fungi. The aim of this study was to test the hypothetical taxonomy (of these fungi) proposed by Upadhyay (1981) and Seifert *et al.* (1993). Morphological characters were coded objectively and analysed using parsimony methods.

MATERIALS AND METHODS

SOURCE OF MORPHOLOGICAL DATA

The data used in this study were compiled from the literature and are based on published descriptions, measurements, photographs and sketches of taxa (Table 1). The greatest proportion of data were extracted from the monograph of Upadhyay (1981). In some cases descriptions were taken from original papers such as those for; *O. novo-ulmi* (Brasier, 1991); *C. virescens* (Davidson, 1944); *C. laricicola* (Redfern *et al.*, 1987); *O. cucullatum* and *O. flexuosum* (Solheim, 1986). Species with incomplete descriptions were excluded. These included *C. autographa* B.K. Bakshi, *C. denticulata* R.W. Davidson, *C. hyalothecium* R.W. Davidson, *C. pseudominor* Olchow. and J. Reid, *Cp. conicollis* (Olchow. and J. Reid) H.P. Upadhyay, *Cp. ochracea* (H.D. Griffin) H.P. Upadhyay, *Cp. retussi* (R.W. Davidson and T.E. Hinds) H.P. Upadhyay, *O. adjuncti* (R.W. Davidson) T.C. Harr., *O. coronata* Olchow. and J. Reid, *O. perparvispora* Hunt, *O. distortum* (R.W. Davidson) de Hoog and R.J. Scheff., *O. europhiodes* (E.F. Wright and Cain) H. Solheim, *O. grande* Samuels and Müller, *O. grandiocarpum* (Kowalski and Butin) Rulamort, *O. novae-zelandiae* (Hutchison and J. Reid) Rulamort, *O. penicillatum* (Grosm.) Siem., *O. polonicum* Siem., *O. polyporicola* Constant. and Ryman, *O. proliferum* (Kowalski and Butin) Rulamort, *O. serpens* (Goid.) Arx, *O. subanulatum* Livingston and R.W. Davidson, *O. valdivanum* (Butin) Rulamort, and *O. wagneri* (Goheen and Cobb) T.C. Harr. *Microascus longirostris* Zukal was included as outgroup to determine the homoplasy of morphological characters (Morton and Smith, 1963).

Table 1. List of taxa[a] used in analyses

1	*C. adiposa* (Butler) C. Moreau
2	*C. angusticollis* E.F. Wright & H.D. Griffin
3	*C. deltoideospora* Olchow. & J. Reid
4	*C. californica* DeVay, R.W. Davidson & Moller
5	*C. coerulescens* (Münch) B.K. Bakshi
6	*C. fagacearum* (Bretz) Hunt
7	*C. fimbriata* Ellis & Halst.
8	*C. laricicola* Redfern & Minter
9	*C. magnifica* H.D. Griffin
10	*C. moniliformis* (Hedgc.) C. Moreau
11	*C. paradoxa* (Dade) C. Moreau
12	*C. populicola* Olchow. & J. Reid
13	*C. radicicola* (Bliss) C. Moreau
14	*C. stenospora* H.D. Griffin
15	*C. tenella* R.W. Davidson
16	*C. tubicollis* Olchow. & J. Reid
17	*C. virescens* (R.W. Davidson) C. Moreau
18	*Cp. alba* (DeVay, R.W. Davidson & Moller) H.P. Upadhyay
19	*Cp. collifera* Marm. & Butin
20	*Cp. concentrica* (Olchow. & J. Reid) H.P. Upadhyay
21	*Cp. crenulata* (Olchow. & J. Reid) H.P. Upadhyay
22	*Cp. falcata* (E.F. Wright & Cain) H.P. Upadhyay
23	*Cp. fasciata* (Olchow. & J. Reid) H.P. Upadhyay
24	*Cp. longispora* (Olchow. & J. Reid) H.P. Upadhyay
25	*Cp. minima* (Olchow. & J. Reid) H.P. Upadhyay
26	*Cp. minuta* (Siem.) H.P. Upadhyay & W.B. Kendr.
27	*Cp. minuta-bicolor* (R.W. Davidson) H.P. Upadhyay & W.B. Kendr.
28	*Cp. pallidobrunnea* (Olchow. & J. Reid) H.P. Upadhyay
29	*Cp. ranaculosus* T.J. Perry & Bridges
30	*Cp. spinulosa* (H.D. Griffin) H.P. Upadhyay
31	*O. abietinum* Marm. & Butin
32	*O. abiocarpum* (R.W. Davidson) T.C. Harr.
33	*O. aequivaginata* Olchow. & J. Reid
34	*O. ainoae* H. Solheim
35	*O. allantospora* H.D. Griffin
36	*O. araucariae* (Butin) de Hoog & R.J. Scheff.
37	*C. arborea* Olchow. & J. Reid
38	*O. aureum* (Rob.-Jeffr. & R.W. Davidson) T.C. Harr.
39	*O. bacillosporum* (Butin & Zimm.) de Hoog & R.J. Scheff.
40	*O. bicolor* R.W. Davidson & Wells
41	*O. brevicolla* (R.W. Davidson) de Hoog & R.J. Scheff.
42	*O. brunneo-ciliatum* Mathiesen-Käärik
43	*C. brunneocrinata* E.F. Wright & Cain
44	*O. cainii* (Olchow. & J. Reid) T.C. Harr.
45	*O. canum* (Münch) Syd. & P. Syd.
46	*O. clavigerum* (Rob.-Jeffr. & R.W. Davidson) T.C. Harr.

47	*O. columnaris* Olchow. & J. Reid
48	*O. conicolum* Marm. & Butin
49	*O. crassivaginatum* (H.D. Griffin) T.C. Harr.
50	*O. cucullatum* H. Solheim
51	*O. davidsonii* (Olchow. & J. Reid) H. Solheim
52	*O. dryocoetidis* (W.B. Kendr. & Molnar) de Hoog & R.J. Scheff.
53	*O. epigloeum* (Guerrero) de Hoog & R.J. Scheff.
54	*O. flexosum* H. Solheim
55	*O. francke-grosmanniae* (R.W. Davidson) de Hoog & R.J. Scheff.
56	*O. grandifoliae* (R.W. Davidson) T.C. Harr.
57	*O. huntii* (Rob.-Jeffr.) de Hoog & R.J. Scheff.
58	*O. introcitrina* Olchow. & J. Reid
59	*O. ips* (Rumbold) Nannf.
60	*O. leptographioides* (R.W. Davidson) Arx
61	*O. leucocarpa* R.W. Davidson
62	*O. megalobrunneum* (R.W. Davidson & Toole) de Hoog & R.J. Scheff.
63	*O. minus* (Hedgc.) Syd. & P. Syd.
64	*O. multiannulatum* (Hedgc. & R.W. Davidson) Fr.
65	*O. narcissi* Limber
66	*O. nigrocarpum* (R.W. Davidson) de Hoog
67	*O. nigrum* (R.W. Davidson) de Hoog & R.J. Scheff.
68	*O. nothofagi* (Butin) Rulamort
69	*O. novo-ulmi* Brasier
70	*O. obscura* (R.W. Davidson) Arx
71	*O. olivaceapinii* R.W. Davidson
72	*O. olivaceum* Mathiesen
73	*O. piceae* (Münch) Syd. & P. Syd.
74	*O. piceaperdum* (Rumbold) Arx
75	*O. piliferum* (Fr.) Syd. & P. Syd.
76	*O. pluriannulatum* (Hedgc.) Syd. & P. Syd.
77	*O. populinum* (T.E. Hinds & R.W. Davidson) de Hoog & R.J. Scheff.
78	*O. robustum* (Rob.-Jeffr. & R.W. Davidson) T.C. Harr.
79	*O. rostrocoronatum* (R.W. Davidson & Eslyn) de Hoog & R.J. Scheff.
80	*O. rostrocylindricum* (R.W. Davidson) Arx
81	*O. sagmatospora* (E.F. Wright & Cain) H. Solheim
82	*O. seticolle* (R.W. Davidson) de Hoog & R.J. Scheff.
83	*O. sparsum* (R.W. Davidson) de Hoog & R.J. Scheff.
84	*O. stenoceras* (Robak) Melin & Nannf.
85	*O. tetropii* Mathiesen
86	*O. torticiliata* Olchow. & J. Reid
87	*O. tremulo-aureum* (R.W. Davidson & T.E. Hinds) de Hoog & R.J. Scheff.
88	*O. triangulosporum* Butin
89	*O. trinacriforme* (Parker) T.C. Harr.
90	*O. ulmi* (Buisman) Nannf.

[a] *C.* refers to *Ceratocystis*, *Cp.* to *Ceratocystiopsis* and *O.* to *Ophiostoma*.

CHARACTER CODING

A total of eight morphological characters, four for the anamorph and four for the teleomorph, were used to describe taxa (Table 2a, 2b). Anamorph characters included type of conidiophore (mononematous and/or synnematous), conidiogenesis, type of anamorph (*Chalara*, *Graphium*, *Hyalorhinocladiella*, *Leptographium* and *Sporothrix*) and conidial morphology. Teleomorph characters included ascoma base, ascoma neck, ostiolar hyphae and ascospore morphology. Characters such as shape of peridial cells, ascomatal ornamentation, length of ostiolar hyphae and conidiophore dimension, were excluded because they were often not mentioned in descriptions.

Morphological characters were described in terms of multi-state characters (Table 2a, 2b). Qualitative characters were described using numerical ranges published by Grylls and Seifert (1993) in a synoptic key to the Ophiostomatoid fungi. Binary states (0 and 1) were used to indicate the presence or absence of character states for the various characters (Table 3).

Where more than one anamorph was present in a taxon, the characters of the synanamorph were also included in the analysis. In the event that only one anamorph was present for a taxon, the anamorph was used as synanamorph for comparative purposes. In taxa where the anamorph is unknown (*C. magnifica* and *C. stenospora*), anamorph characters were treated as missing data.

PARSIMONY AND DISTANCE ANALYSIS

A data set (Table 3) established for each taxon using a wide range of character states (Table 2a, 2b), was analysed using parsimony methods. The most parsimonious tree was derived using heuristic search techniques of PAUP 3.1.1 (Phylogenetic Analysis Using Parsimony) (Swofford, 1993). Unweighted character states were analysed using PAUP and the most parsimonious tree produced. Characters were equally weighted using fractional weighting of character states (Table 4). This was achieved by weighting individual character states. The fractional weight of character states was determined by dividing the greatest number of character states used for each character by the number of character states pertaining to that particular character. Using this approach, a monophyletic outgroup was determined and used to root trees in subsequent analyses.

To simplify later analyses, a subset of 55 taxa was chosen based on the groupings of the tree resulting from equally weighted characters (Fig. 1). Bootstraping (1000 replicates) was done to calculate the confidence intervals of the different branching points on the tree. To determine the contribution of different characters (Table 2a, 2b) to tree topology, perithecial base (1-3, 4-10), perithecial neck (11, 12-21, 22-26), ostiolar hyphae (27, 28-30), ascospore morphology (31-37, 38-43, 44-47), conidiophore (48-49), conidiogenesis (50-51), anamorph type (52-57) and conidial morphology (58, 59-64, 65-69, 70-73, 74-79, 80-84, 85-88), were weighted consecutively, twice as heavily as any other character. Characters were also deleted from analyses consecutively to determine the effect of the absence of characters. *Microascus longirostris* was included in the analysis to determine the effect of homoplasy of morphological characters used to determine tree topologies.

Table 2a. Teleomorph character states used in the morphology data set.

Characterstate		1	2	3	4	5	6	7	8	9	10
1. Perithecial base											
1-3	Base pigmentation	dark brown to black	light brown or olivaceous	white or hyaline	-	-	-	-	-	-	-
4-10	Diameter (µm)	<50	50-100	100-150	150-200	200-300	300-500	>500	-	-	-
2. Perithecial neck											
11	Neck	present / absent									
12-21	Length (µm)	<50	50-100	100-200	200-300	300-500	500-750	750-1000	1000-1500	1500-5000	>5000
22-26	Width at apex	<10	10-20	20-30	30-45	>45	-	-	-	-	-
3. Ostiolar hyphae											
27	Ostiolar hyphae	present / absent	-	-	-	-	-	-	-	-	-
28-30	Type	divergent	parallel	convergent	-	-	-	-	-	-	-
4. Ascospore											
31-37	Shape	oblong to ellipsoidal	curved, allantoid, orange section	fussiform x falcate	appearing sheathed	secondary wall hat shaped	secondary wall pillow shaped	secondary wall same shape as ascospore	-	-	-
38-43	Length (µm)	<3	3-5	5-7	7-10	10-20	>20	-	-	-	-
44-47	Width (µm)	<2	2-3	3-4	>4	-	-	-	-	-	-

Table 2b. Anamorph character states used in the morphology data set.

Characterstate		1	2	3	4	5	6
5. Conidiophore							
48-49	Type	mononematous	synnematous	-	-	-	-
6. Conidiogenesis							
50-51	Type	holoblastic	enteroblastic	-	-	-	-
7. Anamorph							
52-57	Type	*Chalara*	*Graphium*	*Hyalorhinocladiella*	*Leptographium*	*Sporothrix*	other
8. Conidia / Anamorph							
58	Septation	present / absent	-	-	-	-	-
59-64	Shape	globose	ellipsoidal to ovate	oblong to ellipsoidal	clavate	Y or T shaped	fussiform
65-69	Length (µm)	<5	5-7	7-10	10-20	>20	-
70-73	Width (µm)	<2	2-3	3-4	>4	-	-
Conidia / Synanamorph							
74-79	Shape	globose	ellipsoidal to ovate	oblong to ellipsoidal	clavate	Y or T shaped	fussiform
80-84	Length (µm)	<5	5-7	7-10	10-20	>20	-
85-88	Width (µm)	<2	2-3	3-4	>4	-	-

Table 3. Coded data matrix for taxa (Table 1)^a coded according to character states in Table 2.

	Character							
	1	2	3	4	5	6	7	8
1	1000000111	1000000011001100	1100	01001001001100001110	01	01	100000	111000001100011111000001100011
2	1000110000	1000011000001000	1100	10001001110000110001	10	01	010000	001100111101110001100111101110
3	1001100000	1001110000010000	1000	01000000100000100010	10	01	000010	011101110001000011101110001000
4	1000110000	1001110000001100	1100	10001010011000110010	10	01	001000	011000100001100011000100001100
5	1000110000	1000001110001000	1100	01000000110000100010	10	01	000010	011001111101110011001111101110
6	1000011000	1000001100001000	1100	01001001000100010010	01	01	100000	011000011110001011000011110001
7	1000110000	1011000000011000	1110	10001010010000100010	10	01	000010	011110110000011011110110000011
8	1000000110	1000110000000001	1110	11001001001110011010	01	01	100000	011000111001100110001111100110
9	1000011100	1111111100001000	1110	01001100011100010010	01	01	100000	001000001110111001000001110111
10	1000000100	1000001100000110	1100	11001001010000110010	01	01	100000	001000001110001001000001110001
11	1000000111	1000000110001100	0000	01001001100000100010	??	01	???1??	011100001000010011100001000010
12	1000111100	1000001100001000	1100	01001100011000010010	01	01	100000	011000011100111011000011100111
13	1100001100	1000001110000110	1110	01001001001100011110	01	01	100000	011000001100111011000001100111
14	1000110000	1011000000010000	1110	01001001010000110010	10	01	000010	001100100001000001100100001000
15	0101111100	1111111100000110	1100	10001001001110011010	01	01	100000	001000011110111001000011110111
16	1001100000	1011000000001000	0000	01001001011100100000	??	01	000000	??????????????????????????????
17	1000110000	1001110000011000	1100	01000000010000100010	10	01	000010	011100111001100011100111001100
18	1000110000	1010000000001000	0000	10001011010000100010	10	01	001000	011100110001000011100110001000
19	1000001100	1111111100001???	1100	01001001001100100010	??	01	??????	011000011110100011000011110100
20	0010110000	1011100000011000	1011	01101001001100100010	10	01	001000	011101011000110011101011000110
21	1000100000	1100000000010000	1001	00101001000010100010	10	01	000010	110000110001000110000110001000
22	1000100000	1010000000011000	0001	00101001000110100010	10	01	000010	000110100001000000110100001000
23	1001100000	1001000000011000	1110	00101001001100100010	10	01	001000	011100110001100011100110001100
24	1000100000	1100000000010000	0000	00101001000001100010	01	01	100000	001100111001000001100111001000
25	1001100000	1010000000010000	1011	00101001000110100010	10	01	001000	011100100001000011100100001000
26	1001110000	1110000000011000	1001	00101001000110100010	10	01	000010	001110011101110001110011101110
27	1001110000	1100000000001100	1001	00101001000010100010	10	01	001000	011100110001000011100110001000
28	1000100000	1111000000001100	1011	01101001001110100010	10	01	001000	011000110001000011000110001000
29	0101100000	1011100000011000	1001	00101001000011100010	10	01	001000	011000110001000011000110001000
30	1000100000	1100000000011000	1001	01001100000010100010	10	01	000010	001000110001000001000110001000

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31 1001110000-11100000000?????-0000-10101000000110110010-10-01-000010-001100011001000001100011001000
32 1001100000-1100000000010000-1001-00101001000110100010-10-01-000010-110010110001100110010110001100
33 1000011100-1000011000011000-1100-01000000010000010010-10-01-000010-001100110001000001100110001000
34 1000001100-11111111100?????-0000-01000000010000100010-10-01-000100-011000011101100011000011101100
35 1001110000-1001111000011000-1110-01101001110000100010-10-01-001000-111100110001100111100110001100
36 1000110000-1000011000001100-1100-10001001010000100001-10-01-010000-011100111001110011100111001110
37 1000111100-1000001110001100-1010-01000000110000110010-10-01-001000-011100111001110011100111001110
38 1000111000-1000110000001000-0000-01000000010000100011-10-01-011000-011100100001000011100110001000
39 1000000110-0000000000000000-0000-01001100011000011010-10-01-000100-010100011101110010100011101110
40 1000110000-1000110000001100-1100-10000000001110100010-10-01-001000-011100110001100011100110001100
41 0110001110-1000001110000111-0000-10001010011000011010-10-01-001000-011100111001111011100111001111
42 1000011000-1000110000001100-1011-01001001001100011010-10-01-000100-001100111001100001100111001100
43 1000000110-1000001110001100-1100-10001010010000110001-10-01-010000-011000110001000011000110001000
44 1000011110-1000111100000110-0000-01001100011000111001-10-01-010000-001100111001100001100111001100
45 1001111000-1111111100011000-0000-01000000011000110010-10-01-?????1-110000111101111110000111101111
46 1000000111-0000000000000000-0000-01001100011000011110-10-11-010000-001100000110001001100000110001
47 1000111100-1000011000001000-0000-10001010111000110001-10-01-010000-001100110001100001100110001100
48 0100001100-1000001000001100-1101-01000000011000100010-10-01-000010-011100110000011011100110000011
49 1001110000-1110000000001000-1110-00101001000110100010-10-01-000100-001100111101000001100111101000
50 1100110000-1000111000001000-1100-01001100001000011001-10-01-010000-011000111001110011000111001110
51 1000100000-1001110000001100-1010-01001001011000011001-10-01-010000-011000111001100011000111001100
52 1000001100-1001111000000011-1000-01001001001000111010-10-01-000100-011100001100111011100001100111
53 1000011000-1001111000001000-0000-01000000110000100010-10-01-000010-011100110001100011100110001100
54 1000011000-1000001100001000-1100-10001010010000100010-10-01-000010-011110110001110011110110001110
55 1000011000-1001110000000100-1010-01001001011000010010-10-01-000100-111000100001100111000100001100
56 1000011000-1000011100001100-1100-01001001010000100010-10-01-000100-011100100001000011100100001000
57 1000000110-1111111000001110-0000-01001100010000110010-10-01-000100-011000111001111011000111001111
58 1000011100-1000011000001100-0000-01000000110000100001-10-01-010000-001100100001000001100100001000
59 1000011110-1000111110001100-0000-10001010011000110011-10-01-011000-011100111001100111000110000011
60 1000011000-1001000000001100-1110-01001010001100011010-10-01-000100-011000111001100011000111001100
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61	0010011000-1000001100000001-1100-010000001100001000 10-10-01-000010-0011011100011000011011100011 00
62	1000000010-1000000110 0?????-1110-010000001100001000 10-10-01-000010-0111001110011000111001110011 00
63	1000110000-1011000000011000-0100-010000001110001000 10-10-01-001000-0111001100011100111001100011 10
64	1000011100-1111111111111000-1100-110000001100001000 10-10-01-000010-0110011111011100110011111011 10
65	1000011000-1001110000001000-0000-100000001100001000 10-10-01-000010-0111001110011100111001110011 10
66	1001110000-1001000000001000-1100-010000000100001000 10-10-01-000010-0111001100011000111001100011 00
67	1000110000-1001110000001100-1110-100010100100001100 10-10-01-001000-0111001110011000111001110011 00
68	1000000011-1111111111100001-0000-010000000100000100 10-10-01-000010-0100001000010000100001000010 00
69	1000110000-1000111000011000-1100-010000000110001000 11-10-01-010010-0111001111001000110001100011 00
70	1000110000-1000110000001100-1000-110010100110000100 01-10-01-010000-0110001110000110110001110000 11
71	1000001000-1000111000001000-1111-010011000110001100 01-10-01-010000-0110001110011000110001110011 00
72	1000100000-1001110000001100-1010-010011000110000110 01-10-01-010000-0110001110011100110001110011 10
73	1000111000-1000001110011100-0100-010000001100001000 11-10-01-010010-0110000111011100110001100011 00
74	1000001000-1110000000001110-0000-010011000111000110 10-10-01-000100-0110001110001100110001110001 10
75	1000111100-1000011111111000-1110-010000000100001000 10-10-01-000010-0110011110011000110011110011 00
76	1000111100-1000001111011000-1100-010000000100001000 10-10-01-000010-0110011111011000110011111011 00
77	1000001100-1000001110001110-1100-010000000100001100 10-10-01-000010-0110010111011100110010111011 10
78	1000001110-0000000000000000-0000-010011000110000110 10-10-01-000100-0100001110001110100000111000 111
79	1000011000-1001111000001100-1100-010000000110001100 10-10-01-000010-0111001110011000111001110011 00
80	1000011100-1000011000000110-0000-010010011100001000 10-10-01-000100-0111001100011000111001100011 00
81	1000110000-1011110000001100-1010-010011000111000111 01-10-01-010000-0111001110000110111001110000 11
82	1000010000-1001000000000001-1011-100010100110000100 10-10-01-001000-0111001100011000111001100011 00
83	1000011000-1111100000001100-0000-100010100110001100 01-10-01-010000-0110001000010000110001000010 00
84	1000111000-1000011110001000-1100-010000001100001000 10-10-01-000010-0111001100011000111001100011 00
85	1000001110-1000001110001100-1100-010000001100001000 10-10-01-000010-0110001100010000110001100010 00
86	1000011000-1000011110001100-1100-010010011100001000 01-10-01-010000-0111001000010000111001000010 00
87	1000110000-1000011000001100-1010-010000000110001100 10-10-01-001000-0111000110011000111000110011 00
88	1000001100-1000000110001100-1100-010011010100000100 10-10-01-001000-0110001110011110110001110011 11
89	1000000100-0000000000000000-0000-010011000110000110 10-10-01-000100-0110001110011110110001110011 11
90	1000011000-1001110000001000-1100-010000000110001000 11-10-01-010010-0111001111011000110001100011 00

[a] Taxa numbers correspond to those listed in Table 1.

Table 4. Fractional weighting of character states to equally weight characters.

Morphological character	Number of character states	Equal weighting of characters[a]
Teleomorph		
1. Perithecial	10	310
2. Perithecial	16	193
3. Ostiolar	4	775
4. Ascospore	20	182
Anamorph		
5. Conidiophore	2	1550
6. Conidiogenesis	2	1550
7. Anamorph	6	516
8. Conidia	31	100

[a] Equal weight of characters = (x ÷ y) × 100, where,
x - largest number of character states per character (31),
y - number of character states of this character.

RESULTS

Using the heuristic search option on the unweighted data set resulted in 20 equally most parsimonious trees. All 20 tree topologies were incongruent with the accepted classification of the Ophiostomatoid fungi (Seifert *et al*., 1993; Upadhyay, 1981). Species of *Ceratocystis* were thus interspersed with species of *Ophiostoma* and *Ceratocystiopsis* without any obvious pattern consistent with our knowledge of this group.

In the analysis of equally weighted characters using fractional weighting, three trees rooted to midpoint were produced (Fig. 1). The tree topologies were similar, differing only within clusters. The tree topology was such that the species were divided into two groups i.e. species of *Ceratocystis* and species of *Ophiostoma* and *Ceratocystiopsis*. Notable exceptions were species presently residing in *Ceratocystis* (*C. angusticollis*, *C. californica*, *C. deltoideospora*, *C. populicola*, *C. tenella* and *C. tubicollis*) that grouped with species of *Ophiostoma*. *Ceratocystiopsis falcata*, grouped with species of *Ceratocystis*. The *Ceratocystis* group formed a distinct monophyly and was used as outgroup in further analyses. Species of *Ophiostoma* and *Ceratocystiopsis* were found in separate clusters. Species with *Graphium* anamorphs grouped together, including certain species with *Graphium* as well as *Sporothrix* synanamorphs, (*O. araucariae*, *O. ulmi*, *O. novo-ulmi* and *O. piceae*). Species with *Sporothrix* or *Hyalorhinocladiella* anamorphs occurred in two clusters. The first group included only species with *Sporothrix* anamorphs while the second group incorporated species with *Hyalorhinocladiella* anamorphs and some species with *Sporothrix* anamorphs. Species with *Leptographium* anamorphs also resided in a separate cluster. The tree homoplasy index of morphological characters was 0.848 and the consistency index was 0.152.

Based on the dendrogram produced by equally weighting characters (Fig. 1), a subset of 55 taxa, representing the different groups, were selected for further analysis. A single most parsimonious tree was produced using the heuristic search option (Fig. 2). The tree was rooted using species of *Ceratocystis*, including *Cp. falcata*, as outgroup. The *Ceratocystis* group was separate from species of *Ophiostoma* and *Ceratocystiopsis*, with a 98% confidence interval (Fig. 2). The *Graphium* and *Sporothrix* groups both had bootstrap values of 100%. The bootstrap value for the *Leptographium* group was 87% while the *Hyalorhinocladiella* group had a bootstrap value of 95%. The homoplasy index for the tree was 0.775 and the consistency index 0.225. When *M. longirostris* was included in the analysis, it was found to group within the *Leptographium* cluster (Fig. 3).

Weighting various characters did not always produce tree topologies that were congruent with the equal weighting of characters. Weighting perithecial base resulted in nine trees. The grouping topology was similar to that in Figure 2, with differences in the internal rearrangements of the *Graphium* and *Ceratocystis* groups. Weighting of the perithecial neck character produced two trees, with loss of resolution in the *Leptographium* and *Hyalorhinocladiella* groups. Weighting of ostiolar hyphae resulted in nine trees. The *Ceratocystis*, *Graphium* and *Leptographium* groups, with the exception of *O. leptographioides*, maintained resolution. Taxa in the *Sporothrix* and *Hyalorhinocladiella* groups were intermixed with *O. leptographioides*.

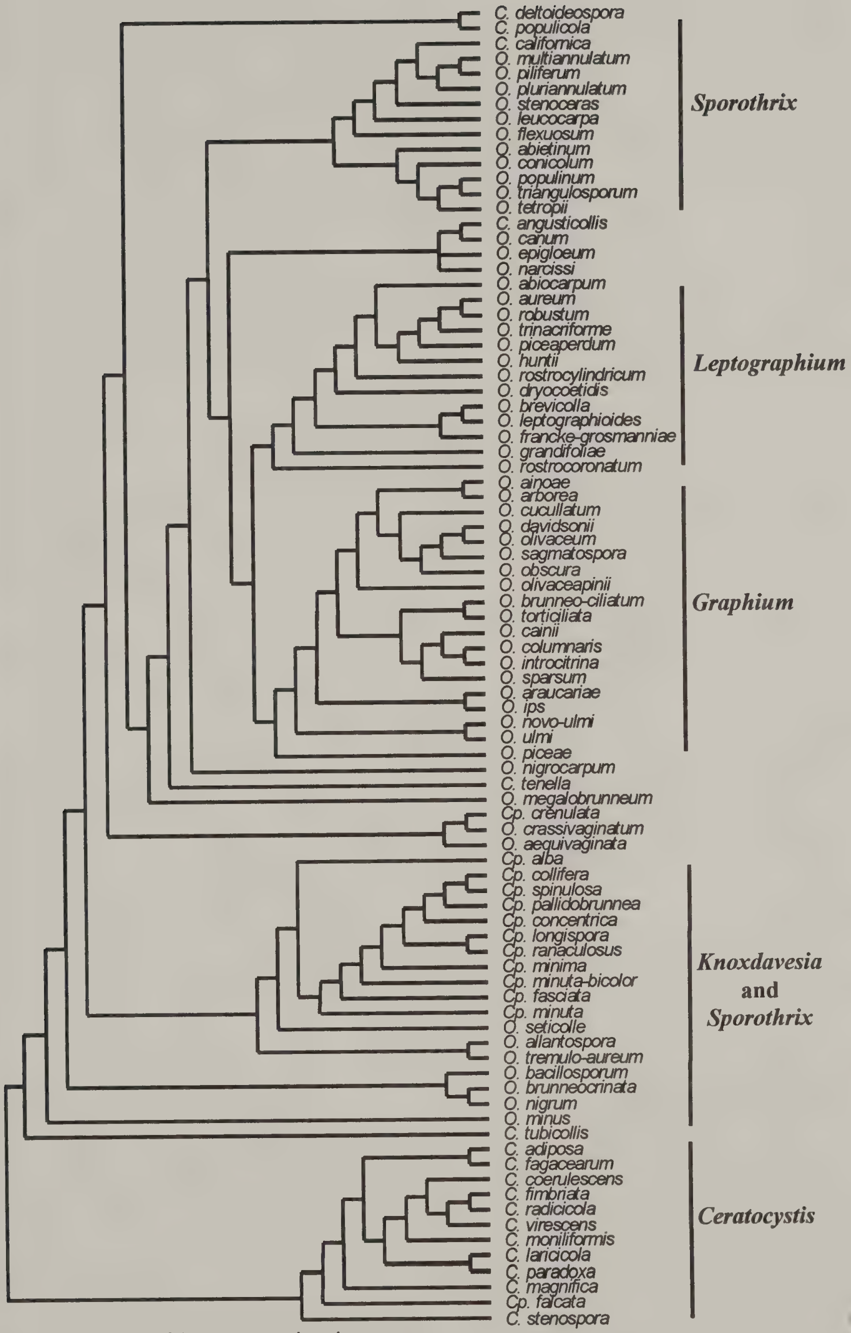
C. deltoideospora
C. populicola
C. californica
O. multiannulatum
O. piliferum
O. pluriannulatum
O. stenoceras
O. leucocarpa
O. flexuosum
O. abietinum
O. conicolum
O. populinum
O. triangulosporum
O. tetropii
C. angusticollis
O. canum
O. epigloeum
O. narcissi
O. abiocarpum
O. aureum
O. robustum
O. trinacriforme
O. piceaperdum
O. huntii
O. rostrocylindricum
O. dryocoetidis
O. brevicolla
O. leptographioides
O. francke-grosmanniae
O. grandifoliae
O. rostrocoronatum
O. ainoae
O. arborea
O. cucullatum
O. davidsonii
O. olivaceum
O. sagmatospora
O. obscura
O. olivaceapinii
O. brunneo-ciliatum
O. torticiliata
O. cainii
O. columnaris
O. introcitrina
O. sparsum
O. araucariae
O. ips
O. novo-ulmi
O. ulmi
O. piceae
O. nigrocarpum
C. tenella
O. megalobrunneum
Cp. crenulata
O. crassivaginatum
O. aequivaginata
Cp. alba
Cp. collifera
Cp. spinulosa
Cp. pallidobrunnea
Cp. concentrica
Cp. longispora
Cp. ranaculosus
Cp. minima
Cp. minuta-bicolor
Cp. fasciata
Cp. minuta
O. seticolle
O. allantospora
O. tremulo-aureum
O. bacillosporum
O. brunneocrinata
O. nigrum
O. minus
C. tubicollis
C. adiposa
C. fagacearum
C. coerulescens
C. fimbriata
C. radicicola
C. virescens
C. moniliformis
C. laricicola
C. paradoxa
C. magnifica
Cp. falcata
C. stenospora
Sporothrix
Leptographium
Graphium
Knoxdavesia
and
Sporothrix
Ceratocystis

Fig. 1. Consensus of three most parsimonious trees.

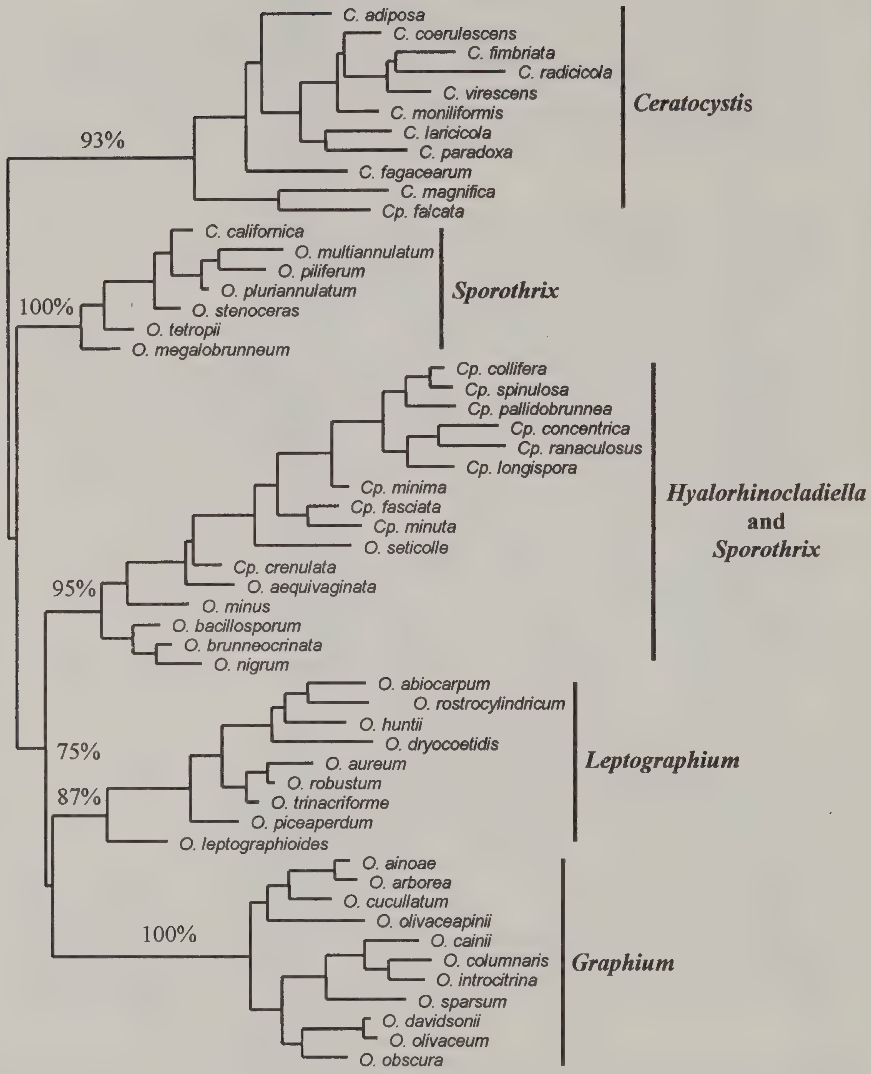
C. adiposa
C. coerulescens
C. fimbriata
C. radicicola
C. virescens
C. moniliformis
C. laricicola
C. paradoxa
C. fagacearum
C. magnifica
Cp. falcata
93%
Ceratocystis
C. californica
O. multiannulatum
O. piliferum
O. pluriannulatum
O. stenoceras
O. tetropii
O. megalobrunneum
100%
Sporothrix
Cp. collifera
Cp. spinulosa
Cp. pallidobrunnea
Cp. concentrica
Cp. ranaculosus
Cp. longispora
Cp. minima
Cp. fasciata
Cp. minuta
O. seticolle
Cp. crenulata
O. aequivaginata
O. minus
O. bacillosporum
O. brunneocrinata
O. nigrum
95%
Hyalorhinocladiella
and
Sporothrix
O. abiocarpum
O. rostrocylindricum
O. huntii
O. dryocoetidis
O. aureum
O. robustum
O. trinacriforme
O. piceaperdum
O. leptographioides
75%
87%
Leptographium
O. ainoae
O. arborea
O. cucullatum
O. olivaceapinii
O. cainii
O. columnaris
O. introcitrina
O. sparsum
O. davidsonii
O. olivaceum
O. obscura
100%
Graphium

Fig. 2. Most parsimonious tree of selected taxa.

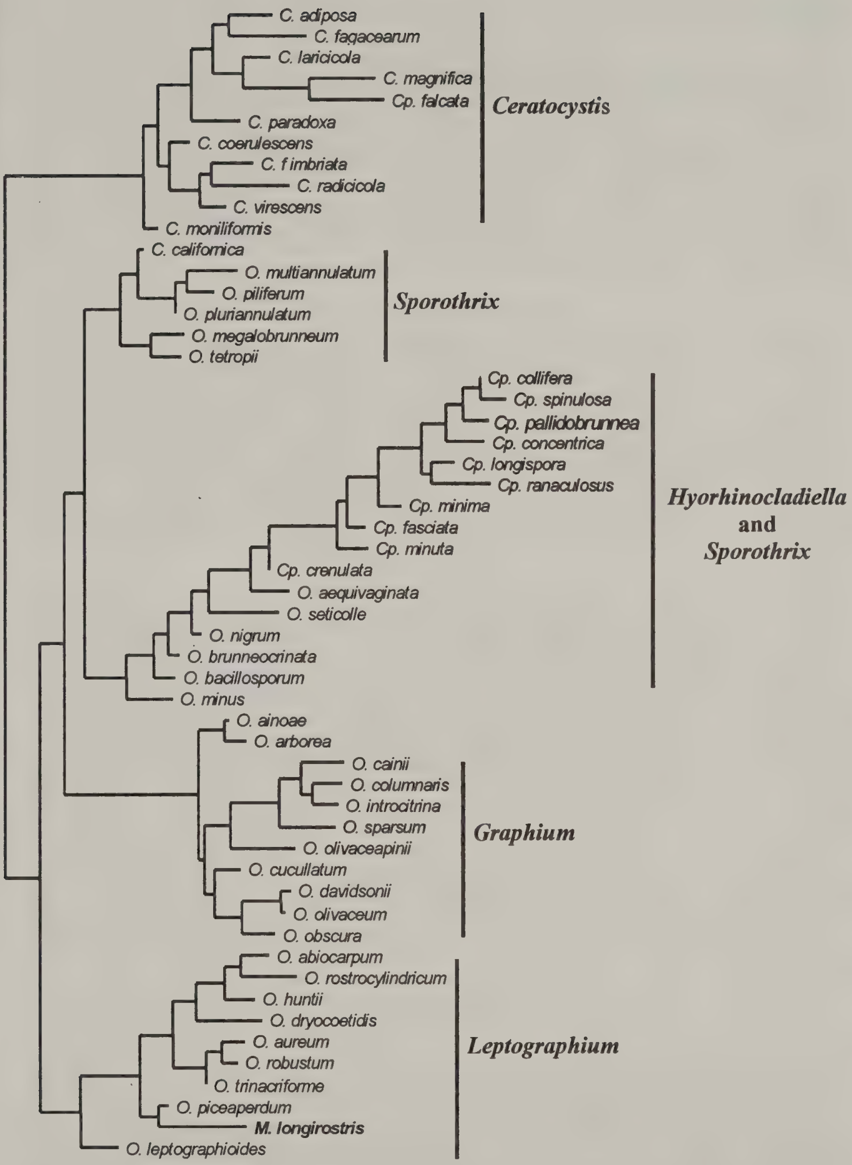
C. adiposa
C. fagacearum
C. laricicola
C. magnifica
Cp. falcata
Ceratocystis
C. paradoxa
C. coerulescens
C. fimbriata
C. radicicola
C. virescens
C. moniliformis
C. californica
O. multiannulatum
O. piliferum
Sporothrix
O. pluriannulatum
O. megalobrunneum
O. tetropii
Cp. collifera
Cp. spinulosa
Cp. pallidobrunnea
Cp. concentrica
Cp. longispora
Cp. ranaculosus
Cp. minima
Hyorhinocladiella
and
Sporothrix
Cp. fasciata
Cp. minuta
Cp. crenulata
O. aequivaginata
O. seticolle
O. nigrum
O. brunneocrinata
O. bacillosporum
O. minus
O. ainoae
O. arborea
O. cainii
O. columnaris
O. introcitrina
O. sparsum
Graphium
O. olivaceapinii
O. cucullatum
O. davidsonii
O. olivaceum
O. obscura
O. abiocarpum
O. rostrocylindricum
O. huntii
O. dryocoetidis
O. aureum
Leptographium
O. robustum
O. trinacriforme
O. piceaperdum
M. longirostris
O. leptographioides

Fig. 3. Most parsimonious tree with *M. longirostris* included in the taxa selection.

Weighting ascospore morphology resulted in two trees with a loss of resolution in the *Hyalorhinocladiella* group.

Weighting anamorph characters had less of an effect on tree topology than it did with teleomorph characters. Weighting conidiophore and anamorph type, resulted in one tree with similar topology to that where characters were equally weighted. Weighting the type of conidiogenesis character produced three trees. The different groups were maintained with internal rearrangements occurring in the *Graphium* group in all the trees. Weighting of conidial morphology produced four trees of which the *Hyalorhinocladiella* group was unresolved and internal rearrangements occurred in the *Graphium* and *Sporothrix* groups.

Deleting characters from analyses had a greater effect on tree topology than did weighting. Deleting perithecial base resulted in 10 trees, all having the same group topology as that in Figure 2, but with internal rearrangements. Excluding perithecial neck resulted in 15 trees. *Ceratocystis magnifica* grouped within the *Leptographium* group and rearrangements occurred in the *Hyalorhinocladiella* and *Leptographium* groups. Deletion of ostiolar hyphae resulted in two trees. Here, species in the *Leptographium* group and *C. virescens* were unresolved. Deleting ascospore morphology resulted in nine trees, in which the *Graphium* and *Sporothrix* groups were maintained. The *Leptographium* group included *C. magnifica* while *Hyalorhinocladiella* was split into two separate clusters.

Deletion of anamorph characters had a similar effect on tree topology as did the deletion of teleomorph characters. Excluding type of conidiophore resulted in three trees. Here, *Ceratocystis* and *Sporothrix* groups were maintained while taxa in the *Graphium*, *Hyalorhinocladiella* and *Leptographium* groups were intermixed. Deleting type of conidiogenesis from the analysis produced five trees in which the *Graphium* and *Sporothrix* groups were maintained. The *Leptographium* group included *C. magnifica* while the *Hyalorhinocladiella* group included *Cp. falcata*. Removing anamorph type resulted in 12 trees in which the groups *Ceratocystis*, *Sporothrix* and *Graphium* were maintained. The *Hyalorhinocladiella* group included *O. leptographioides* with the grouping of other taxa in the *Leptographium* group, unresolved. Deleting conidial morphology from the analysis resulted in 89 trees. All the groups, *Ceratocystis*, *Graphium*, *Sporothrix*, *Leptographium* and *Hyalorhinocladiella* were maintained with rearrangements of taxa occurring within groups.

DISCUSSION

In this study of published morphological characters, the grouping of species in *Ceratocystis s.l.* based on anamorph type suggests that this character is important in the delineation of phylogenetic groups. The exception is that species with *Hyalorhinocladiella* anamorphs form a group that includes species with *Sporothrix* anamorphs. Benade *et al*. (1996) found that the *Hyalorhinocladiella* anamorph is similar to *Sporothrix* and that there is apparently a continuum of developmental stages between these two genera. The clustering of species with similar anamorph type may ultimately form a sound basis of different genera within *Ophiostoma sensu lato*.

Weighting individual character states can be used to cancel the effect of assigning different numbers of character states to different characters. Analysis of equally weighted morphological characters of the Ophiostomatoid fungi produced tree topologies reasonably congruent with those from studies using molecular data (Berbee and Taylor, 1992a; 1992b; Hausner *et al*., 1993; Spatafora and Blackwell, 1993). Results from parsimony analysis, of equally weighted morphological characters, support the view that *Ceratocystis s.s.* is a distinct genus from *Ophiostoma*. Furthermore, in analyses testing the homology of all morphological characters simultaneously, there does not appear to be any justification for separating species of *Ceratocystiopsis* from *Ophiostoma*. This finding based on morphological data is congruent with molecular data that suggests that *Ceratocystiopsis* and *Ophiostoma* form a monophyletic group (Hausner *et al*., 1993).

Using parsimony analysis of equally weighted characters with unrooted trees (rooted to midpoint), species of *Ceratocystis* (with the exception of *C. angusticollis*, *C. californica*, *C. deltoideospora*, *C. populicola*, *C. tenella*, *C. tubicollis* and the inclusion of *Cp. falcata*) were identified as a monophyletic group. We can support the exclusion of *C. angusticollis*, *C. californica*, *C. deltoideospora*, *C. populicola*, *C. tenella*, *C. tubicollis* from *Ceratocystis* based on the fact that these species have anamorphs reminiscent of those in *Ophiostoma* and these species should be transferred to the latter genus (Seifert *et al*., 1993).

The inclusion of *Cp. falcata* in *Ceratocystis* is justifiable as this fungus is more reminiscent of species in *Ceratocystis*. *Ceratocystiopsis falcata* has a *Chalara* anamorph, which is characteristic of species of *Ceratocystis s.s.* However, sequence, RFLP and hybridisation data (Hausner *et al*., 1993; Viljoen *et al*., 1999) suggest that *Cp. falcata* is phylogenetically distant from species of *Ceratocystis*. Ascospore morphology on its own is, therefore, not a good characteristic on which to base genera, as has previously been shown by Hausner *et al*. (1993). It would appear that the characters used in the taxonomy of the Ophiostomatoid fungi are highly convergent. This is supported by high homoplasy values for the trees resulting from PAUP analyses.

Consecutive weighting of morphological characters was useful in determining the effect of those characters on tree topology. Thus, weighting different morphological characters changed tree topology to a greater or lesser extent. Weighting perithecial base, conidiophore, conidiogenesis and anamorph type, did not affect tree topology. However, weighting perithecial neck, ostiolar hyphae, ascospore and conidial morphology resulted in a loss of resolution in one or more groups of taxa. Furthermore, no single morphological character, when weighted, resulted in the simultaneous loss of resolution in all groups of taxa. Therefore, the effect of perithecial neck, ostiolar hyphae, ascospore and conidial morphology on the taxonomy of these fungi is collective. This suggests that groups of characters, rather than single characters, should be used simultaneously in the taxonomy of these fungi. This is unfortunately not possible without the aid of computer based systematics. Results underline the importance of character description in computer systematics.

Removing morphological characters from analyses, placed the weighting of characters in perspective. Perithecial base was the only character that did not change tree topology. Perithecial neck, ostiolar hyphae, ascospore morphology, conidiophore, conidiogenesis, anamorph type and conidial morphology contributed to a wide range of changes in tree topology. No single deleted character resulted in loss of resolution of all the different groups. For example, deleting anamorph type did not change the distinction between *Ceratocystis*, *Graphium* and *Sporothrix* groups. The *Leptographium* group was unresolved with *O. leptographioides* included in the *Hyalorhinocladiella* group. Therefore, the distinction between the groups of taxa, is not solely based on a single morphological characteristic. Furthermore, the low consistency index values and high homoplasy values confirm that the morphological characters, used in the taxonomy of the Ophiostomatoid fungi, are highly convergent. However, the high bootstrap values for the different nodes of the tree is an indication that the grouping of taxa within the trees is valid and is not a result of any single character.

Species of *Microascus* are morphologically similar to the Ophiostomatoid fungi. However, analysis of sequence data (Berbee and Taylor, 1992a; 1992b; Spatafora and Blackwell, 1993) has shown that *Microascus* is phylogenetically distinct from *Ophiostoma*. The inclusion of *M. longirostris* in the *Leptographium* group (Fig. 4) is, therefore, an indication that many of the morphological characters used in the taxonomy of these fungi are highly convergent. This is supported by the high homoplasy value (0.775) for the tree topology.

Computer analysis of morphological characters is error prone, because of the plastic nature of these characters and the way in which they are expressed in a data base. This bias is introduced by reducing a character to an exclusive state, regardless of the variation within that character. Under these conditions, the taxonomist must make the decision that one character state, above all others, best describes a taxon character. Using a binary system to indicate the presence or absence of multi-state characters does not restrict morphological characters from being expressed as selective character states in a data matrix. The advantage of this approach is that the data matrix will reflect shared character states and shared characters. Furthermore, using a combination of multi-state character states in conjunction with a binary system, allows the expression of natural variation within a coded data matrix. The binary coding thus makes it possible to assign each character equal weight or to weight certain characters preferentially. This is useful in determining the effect that different characters have on tree topologies, and can be used to identify divergent or convergent morphological characters.

This study provides an objective taxonomic hypothesis for the Ophiostomatoid fungi based on equally weighted morphological characters. In sumary, the genus *Ceratocyctis s.s.* is distictint from *Ophiostoma* while species of *Ceratocystiopsis* and *Ophiostoma* form a monophyletic group. Despite the high degree of homoplasy of characters, results strongly suggest that anamorph type may be an important character on which further subdivisions, in *Ceratocystiopsis* and *Ophiostoma*, may be based.

We have attempted to address the problems pertaining to character description and different numbers of character states, by using an inclusive approach and equal weighting of morphological characters. The effect is evident when comparing the result of unweighted versus equally weighted characters. Only the analyses of equally weighted characters produced tree topologies congruent to hypothetical classifications. Furthermore, it appears that collections of morphological characters, rather than single characters, are important in the taxonomy of the Ophiostomatoid fungi. The taxonomic hypothesis arising from this morphology study should now be tested using less subjective data sets, such as those derived using molecular techniques.

ACKNOWLEDGEMENTS

This research was supported by the South African Foundation for Research and Development. We would like to express our thanks to the reviewers who made a valuable contribution to the manuscript.

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MYCOTAXON

Volume LXXIV(1), pp. 241-252 January-March 2000

CORTICIOID SPECIES
(BASIDIOMYCOTINA, APHYLLOPHORALES)
FROM COLOMBIA II

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ABSTRACT

26 species are reported as new for Colombia of which *Aleurocystis habgallae*, *Amaurodon viridis*, *Amylocorticium africanum*, *Brevicellicium allantosporum*, *Hyphodontia alutacea*, *H. orasinusensis* and *Leifia flabelliradiata* are new to South America. *Hypochniciellum luteolum* Hjortstam & Ryvarden and *Radulodon venustum* Hjortstam & Ryvarden are described as new. Keys are provided for tropical species of *Amylocorticium*, South American species of *Brevicellicium* and all species in *Candelabrochaete* and *Hypochniciellum*.

INTRODUCTION

The first report on Colombian corticioid fungi (Hjortstam and Ryvarden 1997) provided details of the expedition on which the specimens were collected, where they are deposited, etc. To avoid excessive citations of locality names, the following list indicates where the cited collections were made. Collections numbered 15814 – 15912: Magdalena province, Toyrona national park, at sea level, 14 June 1978; 15913 – 16050: Magdalena province, San Lorenzo, Station Reservo, Sierro Nevada, 1900 m, 16. June 1978.
Species marked with an asterisk are new to Colombia.

LIST OF SPECIES

***Aleurocystis habgallae** (Berk. & Broome) G. Cunn.
Specimen: 15987. A pantropical species originally described from Sri Lanka. The closely related species *A. magnispora* (Burt) P.A. Lemke was reported from Colombia by Ryvarden (1998).

Aleurodiscus mirabilis (Berk. & M. A. Curtis) Höhn.
Specimen: 15999. Originally described from Cuba, this species has a pantropical distribution. For a description see Núñez and Ryvarden (1997).

Amaurodon viridis (Alb. & Schwein.:Fr.) J. Schröt.
Specimens: 16013, 16029. Not previously reported from South America. The species is better known as *Tomentella chlorina* (Massee) G. Cunn. The temperate distribution was shown by Kõljalg (1996). It is further known from Australia (Tasmania), the type locality for *Thelephora viridis* Berk. and *Hypochnus chlorinus* Massee. Malençon (1952) also reported it from Tunisia as *Caldesiella viridis* (Alb. & Schwein.) Pat.

We have also found the species in Venezuela (Estado Bolivar, Las Nieves, Ryvarden 37750, O), where it was rather common and occurred with *Tomentellago aeruginascens* Hjortstam & Ryvarden (second known collection) and *Amaurodon hydnoides* Kõljalg & Ryvarden (type locality).

Amylocorticium africanum Hjortstam
Specimen: 15916. Previously known only from Africa and recorded several times in Malawi, Kenya, and Tanzania. Boidin and Lanquetin (1995) reported it from Ethiopia. There are no other species in the genus as yet recorded in South America. *Amylocorticium africanum* should be easy to recognize by its cream-coloured hymenophore with a distinct and byssoid subiculum and by its suballantoid spores with a pale blue amyloid reaction.

Key to tropical species of *Amylocorticium*

1. Cystidia absent **2**
1. Cystidia present **3**
2. Hymenophore whitish, spores almost allantoid, usually 6-7 x (1.75-) 2-2.5 µm. Morocco and New Zealand .... ***cebennense***
2. Hymenophore pale yellowish or brownish, spores ellipsoid, 4.5-5.5 µm long, becoming dextrinoid. India .... ***indicum***
3. Cystidia as vesicular protuberances on the hyphae, spores suballantoid 5.5-6.5(-7) x 1.5-2 µm. Africa, South America .... ***africanum***
3. With other kind of cystidia, sometimes septate, projecting above the basidia **4**
4. Spores ellipsoid, 4.5-5.5 µm long. Morocco .... ***subincarnatum***
4. Spores narrowly ellipsoid to almost cylindrical, 7.5-8 µm long. Morocco .... ***subsulphureum***

Asterostroma andinum Pat.
Specimens: 15887, 16024. Presumably pantropical. For a key to and descriptions of *Asterostroma* species, see Boidin, Lanquetin and Gilles (1997).

Botryobasidium digitatum (D. P. Rogers) G. Langer
Specimen: 15969. This seems to be the first record since it was described from Panama.

BASIDIOME thin, arachnoid to hypochnoid, greyish white, cystidia projecting slightly and easily observed under a dissecting microscope. HYPHAL SYSTEM monomitic; subicular hyphae with thickened wall or thick-walled, hyaline to very pale yellowish, 7-12 µm wide, other hyphae thin-walled, narrower, hyaline, all hyphae without clamp connections. CYSTIDIA rather sparse, projecting as much as 30-50 µm above the basidia, thin-walled and about 8-10 µm wide. BASIDIA stout, with an indistinct suburniform appearance, 20-25 x 9-12 µm, with four sterigmata and lacking a basal clamp connection. SPORES hyaline, almost broadly navicular, apically obtuse, smooth and thin-walled, 10-12(-13) x 4.5-5 µm, inamyloid, indextrinoid and acyanophilous. There are often immaturely discharged spores which are somewhat smaller.

The four-sterigmate basidia with navicular spores and presence of cystidial elements should be sufficient for recognition. As far as we know, the species is previously known only from the type locality in Panama. The species occupies an uncertain taxonomic position and we are of the opinion that its current placement in *Botryobasidium* is somewhat dubious. It reminds one of *Athelicium stridi* forma *efibulatum* K.H. Larss. & Hjortstam in its basidial morphology and shape of spores, though the latter are considerably smaller in *B. digitatum*. For the time being we maintain the species in *Botryobasidium*.

Botryobasidium subcoronatum (Höhn. & Litsch.) Donk
Specimen: 15928, 15972. This species has a world-wide distribution.

Brevicellicium allantosporum Hjortstam & Ryvarden
Specimens: 15872, 15873. Originally described from Africa, *B. allantosporum* is the most deviating species in the genus due to its small, allantoid spores and strongly encrusted aculeal hyphae. However, it has isodiametric hyphae next to the basidia, typical of *Brevicellicium*.

Key to species of *Brevicellicium* in South America

1. Hymenophore soft or fragile, granular to odontioid, at least the aculeal hyphae strongly encrusted, spores reniform to allantoid, 4 x 1.5-1.8 µm. Brazil, Colombia .... ***allantosporum***
1. Spores differently shaped, mainly subglobose, hymenophore smooth or granular to odontioid, no evident granulation of aculeal hyphae **2**
2. Hymenophore smooth, spores somewhat lacrimoid 4.5-5(-6) x 3.5-4 µm. Colombia .... ***exile***
2. Hymenophore granular or odontioid **3**

3. Basidiome rather hard, hymenophore granular, verrucae more or less globose, spores asymmetric, about 5 µm across. Argentina, Brazil and Venezuela .... ***olivascens***
3. Basidiome rather tough, hymenophore with very dense granules or slightly odontioid, spores subglobose, somewhat angular, 3.5-4 µm diam. Brazil, Colombia .... ***molle***

Candelabrochaete simulans Hjortstam
Specimen: 15978. The genus *Candelabrochaete* is mainly tropical and subtropical and the species are not well known. Specimens are few or known only from the type-collections, but seem, like some species in *Phanerochaete*, to be closely related to each other. *Candelabrochaete. simulans*, described from Thailand, has ellipsoid spores, shorter than those of *C. magnihypha* (Burt) Burds., and also has somewhat narrower cystidia. The latter is evidently a rare species (see Burdsall 1984).

Key to species of *Candelabrochaete*

1. Basidiomes fragile when dried, hymenophore grandinioid to somewhat odontioid with blunt aculei, cystidia septate, thick-walled at least in the upper part and 6-10 µm wide, with thick-walled conidia, spores subglobose 5-5.5 x 4-4.5 µm. South America (Argentina, Brazil) .... ***dispar***
1. Not with this combination of characters, spores ellipsoid or allantoid ... **2**
2. Basidiomes rather thick, spores allantoid 4.5-5(-6.5) x 1.5-2 µm. Mainly in northern hemisphere and South America (Brazil) .... ***septocystidia***
2. Basidiomes thin or moderately thick, spores ellipsoid, narrowly ellipsoid or cylindrical, if allantoid then broader than 2 µm **3**
3. Basidiomes thin and almost pellicular, closely adnate, not separable from he substratum, cystidia thin-walled, non-septate, hyaline and subulate, smooth, spores about 6.5-7 x 2.8-3.5 µm, on bamboo and deciduous wood. South America (Brazil). .... ***adnata***
3. Basidiomes different, cystidia septate **4**
4. Basidiomes rather thick, hymenophore grandinioid to odontioid, cystidia thin-walled, spores ellipsoid 5.5-6 x 3-3.25 µm. Northern hemisphere, eastern Africa and South America (Brazil) .... ***verruculosa***
4. Hymenophore smooth or almost so, but often strongly pilose with protruding cystidia, at least near the base pigmented yellowish brown, moderately thick to thick-walled, spores allantoid to cylindric **5**
5. Spores suballantoid to allantoid (6-)7-8(-9.5) x 3-3.5(-4)µm, cystidia moderately thick-walled. USA (Florida, Louisiana) .... ***langloisii***
5. Spores ellipsoid to ± cylindric, moderately thick to thick-walled **6**
6. Basidiomes robust, cystidia thick-walled, obtuse or sometimes subcapitate, spores almost cylindric 4.25-6(-6.5) x 2.25-3 µm. Africa (Gabon), South America (Brazil) .... ***africana***

6. Basidiomes thin, more or less pellicular, cystidia moderately thick to thick-walled, spores ellipsoid 7
7. Spores short-ellipsoid 4.5-5.5 x 3-3.25 µm, cystidia 6-8(-10) µm wide. South America (Colombia), Asia (Thailand). .... ***simulans***
7. Spores 6-10 µm long **8**
8. Spores ellipsoid 6-7(-8) x 3-4 µm; cystidia 9-15 µm wide. USA (Florida). ....***magnihypha***
8. Spores ellipsoid to cylindrical 6.5-10 x 3-4.5 µm, cystidia 6-10 µm wide. New Zealand. .... ***eruciformis***

****Cericium luteoincrustatum*** Hjortstam & Ryvarden
Specimen: 15876. The species was described from Argentina (Hjortstam and Ryvarden 1986) and reported by Wu (1990) from Taiwan in the genus *Amethicium* Hjortstam. See further Hjortstam (1995).

****Cotylidia aurantiaca*** (Pers.) A.L. Welden
Specimens: 15819, 15835. According to Reid (1965) a very common species in tropical America.

****Dendrothele nivosa*** (Berk. & M. A. Curtis ex Höhn. & Litsch.) P. A. Lemke
Specimen: 15947. A pustulate species with finely rugose spores, about 20-22 x 15-17 µm. Probably rare in North America, West Indies and Asia, (see further Lemke 1964). Cunningham (1963) reported it from Australia.

****Dextrinocystis capitata*** (D.P. Rogers & Boquiren) Gilb. & M. Blackw.
Specimen: 15889. This species seems to prefer palm-trees and bamboo. The genus comes close to *Tubulicrinis*, but is easily separated by having dextrinoid cystidia.

****Gloeodontia discolor*** (Berk. & M.A.Curtis) Boidin
Specimen: 15837. Probably pantropical.

Gloeodontia pyramidata (Berk. & M.A.Curtis) Hjortstam
Specimen: 15993. Reported earlier by Hjortstam and Ryvarden (1997) from Colombia. According to the original description *Gloeodontia americana* Rajchenb. is evidently very similar. The main differences between the species seem to be the less abundant skeletal hyphae and slightly smaller spores in *G. pyramidata*. The former is known only from the type and the name was introduced to replace *Irpex regularissimus* Rick, an invalid name. For further details see Rajchenberg (1987).

Hyphoderma gemmeum (D.P. Rogers) Donk .... **Fig. 1 a-d**
Specimens: 15881, 15960. This species was originally described from Co-

lombia (Magdalena) and is similar to *H. argillaceum* (Bres.) Donk, but separated by slender cystidia and somewhat smaller spores.

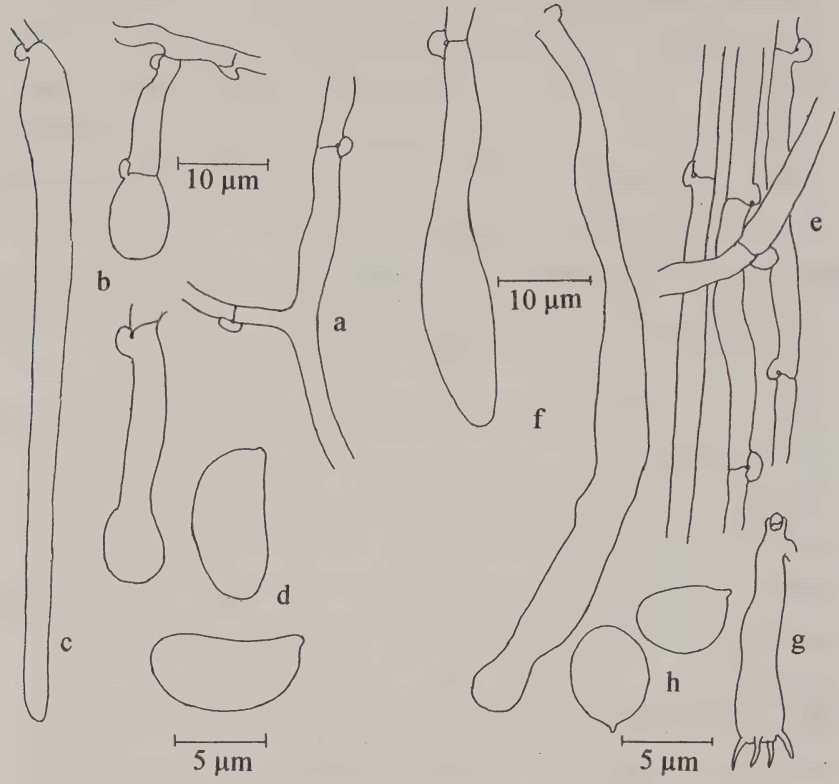

Fig. 1. ***Hyphoderma gemmeum***. Holotype, (Peniophora gemmea) G.W. Martin 3698 (IA). a) hypha b) capitate cystidia c) tubular cystidium d) spores. ***Radulodon venustus***. Holotype, Hjm 16838 e) hyphae f) cystidia g) basidium h) spores.

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Hyphoderma cfr ***obtusiforme*** J. Erikss. & Å. Strid

Specimens: 15986, 15996. The main difference from the European collections is the spores, which are slightly larger than normal for *Hyphoderma obtusiforme.* The Colombian specimens are also strongly reminiscent of *Hyphoderma gigasporum* Boidin & Gilles, described from Reunion (Boidin and Gilles, 1991). In the original description of the latter, the hymenophore was said to be finely odontioid, whereas in the Colombian specimens it is smooth.

Hyphoderma variolosum Boidin et al.
Specimen: 15688. This specimen was erroneously reported as *Hyphoderma heterocystidium* (Burt) Donk by Hjortstam and Ryvarden (1997). *H. variolosum* was originally described from Africa (Central African Republic). For a detailed description, illustration and discussion see Boidin, Lanquetin and Gilles (1991).

****Hyphodontia alutacea*** (Fr.) J. Erikss.
Specimen: 15981. *Hyphodontia alutacea* has not previously been collected from subtropical or tropical areas and was an unexpected species in this collection, since it is typical of coniferous wood in the temperate zone. However, morphologically the Colombian specimen is identical with those from Northern Europe.

Hyphodontia niemelaei Sheng H. Wu
Specimens: 15918, 15996/B. The species is very similar to *H. apacheriensis* (Gilb. & Canf.) Hjortstam & Ryvarden and seems only to be separated by somewhat narrower spores. Hyphodontia niemelaei was originally described from Taiwan (Wu 1990) and reported by Langer (1994) from Colombia and Cameroon. Further investigation seems necessary to confirm the separation of the two species.

****Hyphodontia orasinusensis*** Gilb. & M. Blackw.
Specimen: 16048. Previously known only from the type (USA, Louisiana). For a detailed description and illustration, see Gilbertson and Blackwell (1988). One of the most striking characteristics of the species is that the basal hyphae lack clamp connections. *Hyphodontia microspora* J. Erikss. & Hjortstam is similar, but has somewhat narrower spores (1.5-2 µm) and clamp-connections at all septa. *Odontia palmae* Rick ex Rambo was considered to be an illegitimate name (nomenclatural not mentioned in the protologue) by Hjortstam and Ryvarden (1982) and the same as *H. microspora,* but later on taken up as an independent species by Langer (1994). There is, however, a discrepancy between Langer's spores measurements and Hjortstam and Ryvarden's descriptions of the specimen. Langer indicates the width to be 2.5-3 µm, whereas Hjortstam and Ryvarden give 1.5-1.75(-2) µm. In a re-examination of the type we find the spores variable, but approximately the same size as in *H. microspora*. We still believe that *Hyphodontia palmae* Rick ex E. Langer is a synonym of *H. microspora*. Further, Langer cited the type as a Lectotype, but it should be the Holotype. *H. palmae* is known only from the type (portion in O).

Hypochniciellum luteolum Hjortstam & Ryvarden **nov. sp.**
Basidioma resupinatum, laxe adnatum, pelliculare vel membranaceum. Hymenophorum leve, plus minus luteolum. Subiculo distincto, albido, margine

indefinito, rhizomorphis inconspicuis vel nullis. Systema hyphale monomiticum; hyphis subicularibus tenuitunicatis, modice ramosis, leviter incrustatis, 2-3 µm latis, hyphis ceteris semilibus sed 3-4 µm latis. Hyphae omnes fibulatae. Basidia subcylindracea (10-)12-15(-20) x 3.5-4 µm, 4 sterigmatibus, sporis levibus, crassitunicatis, late ellipsoideis, 2.75-3 x 2-2.25 µm, pallide amyloideis.

Holotypus: Colombia, Magdalena, Sierra Nevada de Santa Marta, Reserva Forestal San Lorenzo, 17-19 June 1978, Leif Ryvarden No. 15952 (O). Isotypi: (GB and Hjm private herb.).

BASIDIOME resupinate, loosely adnate, thin. HYMENOPHORE smooth, pellicular to membranous, pale yellow with the margin indefinite and without conspicuous hyphal strands, subiculum distinct, greyish white to white. HYPHAL SYSTEM monomitic; subicular hyphae thin-walled, moderately branched, hyaline, 2-3 µm wide, some encrusted with rather small crystals. Other hyphae similar or slightly broader and up to 4 µm wide. All hyphae with clamp connections. CYSTIDIA absent. BASIDIA subcylindric, (10-)12-15(-20) x 3.5-4 µm, with four sterigmata and a basal clamp connection. SPORES smooth, becoming thick-walled, short ellipsoid, slightly variable in size, normally 2.75 -3 x 2-2.25 µm, with a distinct or weakly amyloid reaction, acyanophilous or with a weak reaction in Cotton blue.

This species behaves a resemblance to the generic type of *Hypochniciellum* in its pellicular and smooth fruitbody, hyphae with clamp connections, and lack of cystidial elements. The basidia are fairly small and the spores are at least slightly thick-walled. The main difference is the weakly amyloid spores. The genus *Amyloathelia* should also be considered, but *Amyloathelia* species have larger spores, generally 6-11 µm long, which are besides, distinctly amyloid. Small and smooth spores can also be seen in *Trechispora*, though never with an amyloid reaction, and the hyphal septa are typically ampullate. For the time being we prefer *Hypochniciellum* as the most appropriate genus for the new species.

Key to *Hypochniciellum*

1. Cystidia present , but generally few, spores 5.5-7 x 2.5-3.5 µm. Europe, North America, Canary Islands, mostly on coniferous wood .... **molle**
1. Cystidia absent **2**
2. Spores inamyloid, 4-5 x 2.5-3 µm. Europe, North America, Kenya, India .... **ovoideum**
2. Spores weakly amyloid **3**
3. Spores 6-8 µm long **4**
3. Spores shorter, 4.5(-5) µm long.. **5**

4. Spores 6-8 x 4-5 μm (Rajchenb. and Wright, 1987) Argentina. **iaganicum**
4. Spores 5-7 x 3-4 μm, Europe and possibly Argentina .**cremeoisabellinum**
5. Spores 3.5-4.5 x 2.5 μm, on coniferous wood. Europe (Sweden), North America, Canary Islands .... **subillaqueatum**
5. Spores 2.75-3 x 2-2.25 μm .... **luteolum**

*****Leifia flabelliradiata*** (J. Erikss. & Hjortstam) Ginns
Specimen: 16003. Previously not recorded from South America. The species was originally described as *Phanerochaete flabelliradiata* J. Erikss. & Hjortstam (1981). Later Burdsall (1985) transferred it to *Tubulicrinis*, mainly due to the morphology of the cystidia. Hjortstam (1986) made it the type species of the monotypic *Granulocystis*, being unaware that the name was preoccupied. Finally Ginns (1998) proposed *Leifa*.
The distribution is not well known, but it has been collected several times in Northern Europe and Ginns and Lefebvre (1993) listed it from a few states in Canada and USA. From subtropical and tropical areas it was reported from Taiwan (Wu 1997) and Thailand (Hjortstam and Larsson 1995).
The significant microscopical details are hyphae without clamp connections, thick-walled cystidia swelling at least in KOH, and ellipsoid to suballantoid spores.

Lindtneria cfr. ***chordulata*** (D.P. Rogers) Hjortstam
Specimen: 15870. The specimen is slightly deviating in lacking clamp connections and in having inconspicuously ornamented spores. The specimen seems to be identical with Ryvarden 15756, reported by Hjortstam and Ryvarden (1997) under this name. It should also be noted that these clamp-less specimens are quite similar to *Cristinia brevicellularis* Hjortstam (Hjortstam and Grosse-Brauckmann 1993), but the smooth and slightly larger spores of the latter are sufficient for a definite separation.

****Phanerochaete australis*** Jülich
Specimen: 15816. This seems to be a rather common species in South America. It is very similar to *P. flavocarnea* (Petch) Hjortstam (from Sri Lanka), but may be separated by a paler hymenophore and slightly smaller spores.

****Phanerochaete filamentosa*** (Berk. & M. A. Curtis) Burds.
Specimen: 15946. This species is quite similar to and probably confused with both *P. radicata* and *P. borneensis*. See further Nakasone, Bergman, and Burdsall (1994).

Phanerochaete subquercina (Henn.) Hjortstam
Specimen: 16031. A rather poor specimen and the determination is somewhat uncertain. Previously it was reported from South America by Hjortstam and

Larsson (1995). The species is described several times in the literature, as *Odonticium australe* D. A. Reid (Galapagos Islands), *Phanerochaete radulans* Hallenb. (Iran), *Odontia subirpicoidea* Rick (Brazil), and *Radulum subquercinum* Henn. (Java). Though it lacks clamp connections at all septa, its position in *Phanerochaete* is uncertain and is more probably related to species of *Mycoacia*.

Phlebia livida (Pers.:Fr.) Bres.
Specimen: 15976. Seems to be a cosmopolitan species.

Phlebia tremellosa (Schrad.: Fr.) Nakasone & Burds.
Specimen: 16040. A tiny specimen, but the determination is certain. This is a cosmopolitan species although rare in tropical areas.

Phlebiella cfr. ***vaga*** (Fr.) P. Karst.
Specimen: 16033.

Phlebiopsis ravenelii (Cooke) Hjortstam
Specimens: 15818, 15900 (on palm tree). Both this species and *P. flavidoalba* have been described from USA, (South Carolina and Georgia respectively) and are presumably pantropical. The latter is similar to *P. ravenelii*, but has larger spores, often up to 6-7 x 4.5-5 µm, whereas in *P. ravenelii* they are 4.5-6 x 2.5-3 µm.

Radulodon venustus Hjortstam & Ryvarden **nov. sp.** .... **Fig. 1 e-h**
Basidioma resupinatum, arcte adnatum, distincte aculeatum; aculei circiter 2 mm longi, conici, simplicis vel aggregati. Color initio albidum tum plus minus stramineum. Systema hyphale monomiticum; hyphae tenuitunicatae vel crassiusculae, 2.5-3.5(-4) µm latae, fibulatae. Cystidia tubulosa, tenuitunicata, constricta vel sinuosa, 50-80(-150) x 6-8 µm. Basidia subclavata, leviter constricta, generaliter 20 x 5 µm, 4 sterigmatibus. Sporae subglobosae, tenuitunicatae, leves, 4.5-5 x 3.5 µm, neque amyloideae neque dextrinoideae.

Holotypus: Brazil, Sao Paulo, Cananeia, Ilha do Cardoso, on bark of palm, 2-5 Feb. 1987, Hjortstam 16838 (K).
Paratypi: ditto, on wood of deciduous trees, L. Ryvarden 24717 (GB, K). Colombia L. Ryvarden 15910/B (GB).
Etymology: venustus = graceful

BASIDIOME resupinate, closely adnate. HYMENOPHORE distinctly hydnoid with about 2 mm long, conical aculei, usually solitary but sometimes aggregated, smooth or more commonly with small outgrowths along the side. HYPHAL SYSTEM monomitic; hyphae thin-walled or with slight wall thickening, 2.5-3.5(-4) µm wide, closely intermingled in the subiculum and the centre part of the aculei, all hyphae with clamp connections. CYSTIDIA rather frequent, 50-80(-150) x 6-8 µm, mostly of subhymenial origin, with a rather dense protoplasm (KOH and Melzer's reagent), tubular, thin-walled, constricted and sinuous. BASIDIA subclavate, 18-20(-25) x 4-5 µm, with four sterigmata and a basal clamp connection. SPORES subglobose, smooth, thin-walled, 4.5-5 x 3.5 µm, with homogeneous contents, inamyloid, indextrinoid.

This species is strongly reminiscent of other species in *Radulodon*, except that the spores are thin-walled. Otherwise, and especially in its hyphal texture, hydnoid basidiome and subglobose spores, the species conforms to the concept of the genus.

****Resinicium friabile*** Hjortstam & Melo
Specimen: 15982. The species is very similar to *R. bicolor* (Alb. & Schwein.: Fr.) Parmasto, but has differently shaped spores. See Hjortstam and Melo (1997).

****Stereopsis radicans*** (Berk.) D. A. Reid
Specimens: 15862, 15885. According to Reid (1965) a pantropical species.

****Trechispora clanculare*** (Park.-Rhodes) K. H. Larss.
Specimen: 15903. Confirmed by K H Larsson. In South America previously known only from Brazil, see Hjortstam and Larsson (1995).

****Vararia sphaericospora*** Gilb.
Specimens: 15980, 15994. In South America previously known from Argentina (Iguazu) and Brazil (São Paulo), see Hjortstam and Larsson (1995).

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MYCOTAXON

Volume LXXIV(1), pp. 253-254 January-March 2000

ONLINE RESOURCES FOR FUNGAL TAXONOMY & NOMENCLATURE: Collections Online

Kathie T. Hodge
WWW Virtual Library: Mycology
http://mycology.cornell.edu/

> ...a vast backlog of environmental data is lying unused
> in institutions all around the world.
> D.G. Green, 1994
> http://www.csu.edu.au/.WWW/people/dgg/taxon.htm

One impetus for developing databases for herbaria and culture collections has been to facilitate collection management; Lane suggests a broader goal: to provide the widest possible audience with access to biological information. Herbaria and culture collections are potentially vast sources of data for ecologists, policy-makers, natural products chemists, geneticists, biogeographers, systematists, and conservationists. After all, it is through use that collections increase in value.

Lane: Roles of Natural History Collections
http://www.mobot.org/MOBOT/research/Rolenathistcol.html

TOOLS FOR DATABASING

The major obstacle to collection computerization is the cost in time and money for data entry. But assuming computerization is inevitable and you might as well get started, your first task is to decide on a software platform on which your data can grow. Until recently, most institutions developed their own software, resulting in a handful of applications that are powerful but proprietary, and not easily transferable to other collections.

MODELS

It's tempting to begin computerizing a collection using one's favorite spreadsheet or database software. Some have thought very deeply about collection issues, however, and conceived information models that not only facilitate data management but will in future facilitate data exchange. The International Working Group on Taxonomic Databases (TDWG) presents a synthesis of models and associated standards:

TDWG http://www.tdwg.org/

Every institution will customize to some extent, but there are now enough high-quality collection management systems that building your own may be unwarranted. Significant benefits of going with a precompiled package include support, compatibility with mainstream data models, and quick start-up. Costs may include cessation of upgrades, limited possibilities of customization, and problems stemming from the peculiarities of your data. Below is a selection of available systems developed with biological collections in mind.

BIOTA	http://viceroy.eeb.uconn.edu/biota
BRAHMS	http://www.brahms.co.uk/
HSQL	http://www.nacse.org/databases/
SPECIFY	http://www.usobi.org/specify/Docs.html
TRACY	http://www.csdl.tamu.edu/FLORA/input/inputsys.html

RESOURCES

Next, the endless tedium of data entry! Maybe you can use a scanner; maybe you need a team of skilled keyboardists. Many data to be entered are universal, for example, authorities, localities, taxon names, and addresses. And some of this information is available on the internet, saving you the trouble of typing them in yourself. Authors who have described taxa covered by the botanical code can be sought in the online databases at Kew. Index Herbariorum online provides addresses for herbaria world wide. The Plant Names project promises to provide distributed databases of bibliographical data for seed plant species (maybe fungi too, someday?), and Index Nominum Genericorum (Plantarum) online provides generic names. There are few large online databases of fungal species names as yet; Species 2000 is one project with that goal.

Authors of Plant Names (Kew)	http://www.rbgkew.org.uk/web.dbs/webdbsintro.html
Index Herbariorum	http://www.nybg.org/bsci/ih/ih.html
Plant Names Project	http://pnp.huh.harvard.edu/
Index Nominum Genericorum (Plantarum)	http://www.nmnh.si.edu/ing/
Species 2000	http://www.sp2000.org/

THE HUMAN SIDE

We've not even touched on the practical aspects of data quality control, validation, alpha taxonomy, classification systems, determination histories, handwriting interpretation, vague locality data, specimen quality, back-up systems… There's a lot of work to be done.Many culture collections have developed computerized databases; fewer herbaria have. Mycological collections are listed at the WWW VL: Mycology; there are too many to list here.

WWW VL: Mycology, Collections	http://mycology.cornell.edu/fcollect.html

MYCOTAXON

Volume LXXIV(1), p. 255 January-March 2000

ANNOUNCEMENT

NEW BOOK REVIEW EDITOR

We are pleased to announce that Professor David L. Hawksworth, MycoNova, 114 Finchley Lane, Hendon, London, NW4 1DG, United Kingdom (formerly Director of the International Mycological Institute), has accepted appointment to the post of Book Review Editor of MYCOTAXON effective with volume 74. Authors and publishers should submit their publications to be reviewed in MYCOTAXON directly to him. Dr. Hawksworth can be reached also by E-mail at <myconova@btinternet.com> and by Phone/FAX at (+44-8) 203-4282.

Dr. Eric H. C. McKenzie, Landcare Research, Auckland, New Zealand served as our Book Review Editor from 1997 to1999 (volumes 63-73). We would like to express our gratitude for improving the Book Review section, writing reviews, and participating in informing the mycological community on new literature.

Pavel Lizoň
Editor-in-Chief

Publication Date for Volume Seventy-Three

MYCOTAXON for October-December 1999, volume 73: 1-526
was issued on January 10, 2000.

MYCOTAXON is published quarterly during the periods of January–March, April–June, July–September, and October–December by Mycotaxon, Ltd., 316 Richard Pl., Ithaca, NY 14850–0264. Periodical postage paid at Ithaca, NY, and at additional mailing offices. Subscription rates (year 2000 only): In U.S. and possessions, one year, $201.00; reduced rate for personal subscribers, one year, $96.00. Foreign subscriptions, add $6 for surface mail, or add $30 for ISAL air mail.POSTMASTER: Send address changes to Mycotaxon, Ltd., P.O. Box 264, Ithaca, NY 14851-0264.

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Fungi of China, by S. C. Teng. Mycotaxon, Ltd. 1996. Hardbound, xiv + 586 pp., 426 illustrations, map, portrait, index, 8-1/2x11 inches. $79.00. Airmail price varies by country: enquire. ISBN 0-930845-05-6.

Edited by Richard P. Korf, with a foreword by Teng's daughter, Rosaline Z. Deng.

What reviewers have to say about Teng's Fungi of China

"... one of the most valuable books on the fungi of China ever published in English."
Mycologia 90: 1091-1092, 1998.

"... a great big blue uncompromising brick of a book ... an instant classic. Anyone interested in identification of fungi, particularly in Asia, should get this book immediately. Mycology owes another debt to Dick Korf for his sympathetic and intelligent editing of this superb work."
Bibliography of Systematic Mycology 10(6): xlviii-xlix. 1998.

"The publication of Teng's work now gives taxonomists easy access to the contributions of this remarkable scientist without having to undertake a fastidious searching in libraries." — *Sydowia* 48: 277-278. 1997.

"The book is important for any researcher interested in the systematic relationships, diversity, and distribution of fungi on a global scale."
New Zealand Journal of Botany 35:265-266. 1977.

"An extensive index to all taxa ... makes this book readily accessible to the user. It should be present in every public and private mycological library."
Persoonia 16: 424. 1997.

Italians in the History of Mycology: *Proceedings of a symposium held in the Archivo Centrale dello Stato, Rome, 4-5 October 1995,* edited by Silvano Onofri, Antonio Graniti, & Laura Zucconi. Mycotaxon, Ltd. 1999. Softbound, 163 pp., illustrated, 16.5 x 23.5 cm. $35.00 plus postage. (Please ***order direct*** from Accademia Nazionale delle Scienze, detta dei XL, Villa Lontana, Via Cassia Antica 35, 00190 Roma, Italy, e-mail: acc.scienze@flashnet.it, fax: +39 06 3630057). ISBN 0-930845-09-0.

Twenty-one authors discuss contributions from Plinius the Elder onwards, specifically of Aldrovandi, Micheli, De Notaris, Inzenga, Carmignani, Arcangeli, Pellegrini, Saccardo, Bresadola, Tassi, Mattirolo, and Ciferri, and collections in herbaria in Rome and Genoa.

Lichenographia Thomsoniana: *North American Lichenology in honor of John W. Thomson,* edited by M. G. Glenn, R. C. Harris, R. Dirig & M. S. Cole. Mycotaxon, Ltd. 1998. Softbound, 448 pp., illustrated, 6x9 inches. $35.00. (Please ***order direct*** from Mariette Cole, 3010 West 112th St., Bloomington, MN 55431, U.S.A., e-mail: bcole@pclink.com). ISBN 0-930845-08-0.

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Mycotaxon Cumulative Index for Volumes XLI-LX (1991-1996), by Karen D. Gettelman, Richard P. Korf, Susan C. Gruff, and Ian F. Korf. Mycotaxon, Ltd. 1998. Softbound, 296 pp., 6x9 inches. $35.00. Airmail, $55.00. ISBN 0-930845-07-2.

Author and taxon indexes to volumes 41-60 of Mycotaxon.

Biodiversity of Tropical Microfungi, edited by Kevin D. Hyde. University of Hong Kong Press. 1997. Softbound, xiv + 421 pp., illustrated, 6-1/2x9-1/2 inches. $57.50 by surface mail, $64.00 by air mail (shipped from Hong Kong). ISBN 962-209-422-8.

A first look at the diversity of tropical microfungi. Twenty-one chapters by an international set of widely respected authors.

A Monograph of the Fungus Genus Cercospora, by Charles Chupp. Published by the author, Ithaca. 1953. Hardbound, 667 pp. 222 illustrations, octavo. $25.00. Airmail, $40.00. (No ISBN.)

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MYCOTAXON

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Volume LXXIV, No. 2 April-June 2000

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ISSN 0093-4666 MYXNAE 74(2):257-546 (2000)

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MYCOTAXON

Volume LXXIV(2), pp. 257-266 April-June 2000

STUDIES ON CERCOSPORA AND ALLIED GENERA IN CHINA I [1]

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Twenty seven species of *Cercospora,* 1 species of *Mycovellosiella* and 2 species of *Pseudocercospora* are reported. Of which, 4 are new species: *Cercospora acericola* Y. L. Guo & Y. Jiang on *Acer* sp., *C. euonymigena* Y. L. Guo & Y. Jiang on *Euonymus japonicus* L., *C. sambuci* Y. L. Guo & Y. Jiang on *Sambucus buergeriana* Blume, *Mycovellosiella rhoidis* Y. L. Guo on *Rhus* sp., and 6 are new records for China: *Cercospora asclepiadis* Ellis, *C. gomphrenae* Ray, *C. negundinis* Ellis & Everh., *C. siphocampyli* Chupp & Viegas, *Pseudocercospora asclepiadina* (Speg.) Deighton, *P. ubicola* (Yen) Deighton. Latin diagnoses, descriptions and illustrations of the new species are given. Specimens examined are deposited in HMAS.

Cercospora acericola Y. L. Guo & Y. Jiang. sp. nov. Fig.1

Maculae amphigenae, suborbiculares vel irregulares, 2-10 mm latae, pallide brunneae vel pallide rubro-brunneae. Caespituli amphigeni. Stromata nulla vel minutissima ex cellulis globosis brunneis composita. Conidiophora solitaria vel 2-11 fasciculata, modice brunnea vel brunnea, erecta vel curvata, non ramosa, 1-4 geniculata, 1-8 septata, 21.5-120.0(-194.0)×6.5-8.6μm. Cicatrices conspicue incrassatae, 3.2-4.3μm latae. Conidia obclavata, hyalina, erecta vel curvata, ad apicem obtusa vel rotundata, ad basin obconico-truncata, indistincte 3-13 septata, 43.0-216.0 × 5.4-8.6(-10.3)μm.

Hab. in foliis vivis *Aceris* sp. (Aceraceae): Shennongjia, Hubei Provincia (HMAS 77309, Holotypus).

Leaf spots amphigenous, subcircular to irregular, 2-10 mm wide, often confluent, pale brown to pale reddish brown, with dark brown to dark reddish brown halo on the upper surface, yellowish brown to greyish brown on the lower surface. Fruiting amphigenous, chiefly hypogenous. Stromata none or only a few brown globose cells. Conidiophores solitary or 2-11 in a fascicle, moderately brown to brown, paler towards the apex, irregular in width, straight to curved, not branched, 1-4 geniculate, conically truncate to truncate at the apex, 1-8 septate, mostly 1-3 septate, 21.5-120.0(-194.0) ×

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[1] Supported by the National Natural Science Foundation of China

6.5-8.6μm. Conidial scars conspicuously thickened, 3.2-4.3μm wide. Conidia obclavate, hyaline, straight to curved, apex obtuse to rounded, obconically truncate at the base, indistinctly 3-13 septate, 43.0-216.0 × 5.4-8.6(-10.3)μm.

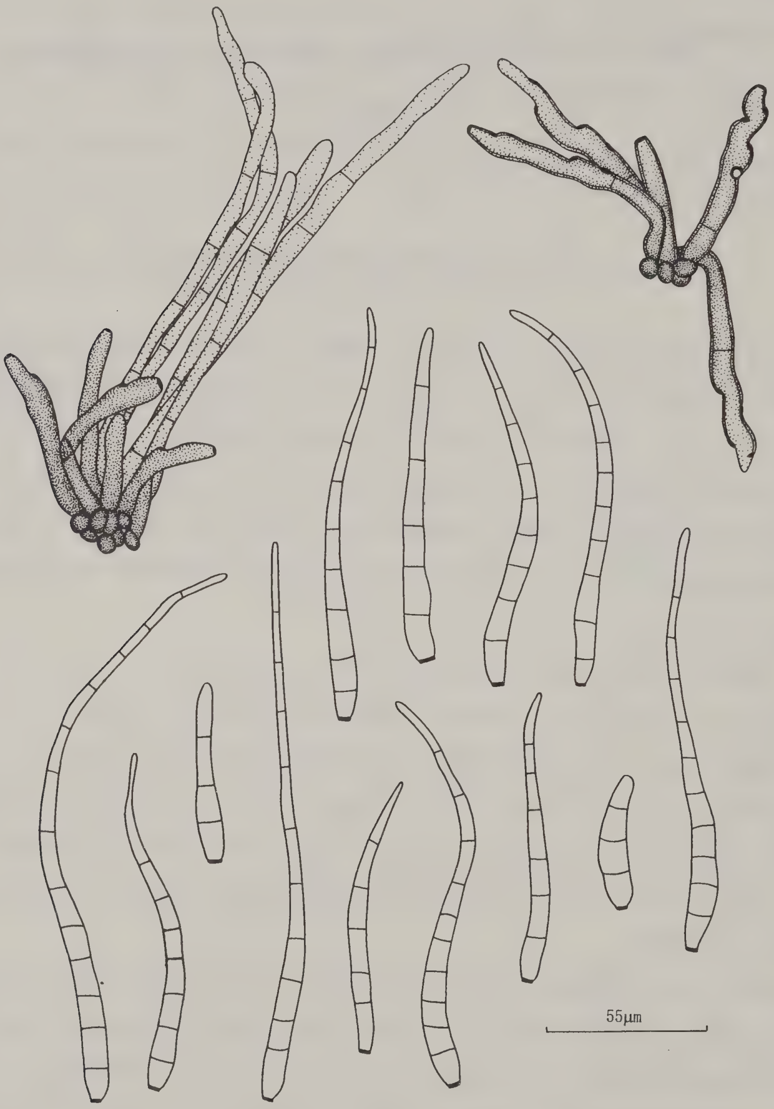

Fig.1 *Cercospora acericola* Y. L. Guo & Y. Jiang

Cercospora saccharini Lib. & Boewe (1960) on *Acer saccharinum* L. is similar to the new species. It differs from this fungus by its angular spots, larger stromata (30-45μm diam.), shorter conidiophores (22.0-54.0 × 5.0-7.0μm), and acicular to cylindrical, narrower conidia (38.0-124.0 × 3.0-3.5μm).

Cercospora achyranthina Thirum. & Chupp, Mycologia 40:352, 1948.

On *Achyranthes aspera* L.(Amaranthaceae): Yuanjiang, Yunnan Province (HMAS 77312).

On *Achyranthes bidentata* Bl.: Pengxian, Sichuan Province (HMAS 77313).

Cercospora alangii Y. L. Guo, Mycosystema 5:109, 1992.

On *Alangium chinensis* (Lour.) Harms (Alangiaceae): Shitai, Anhui Province (HMAS 62765, Type).

On *Alangium kurzii* Craib: Shangsi, Guangxi Province (HMAS 76355).

Cercospora alocasiae Sawada ex T. K. Goh & W. H. Hsieh, Trans. Mycol. Soc. R.O.C. 2:86, 1987.

Cercospora alocasiae Saw. Taiwan Agr. Rev. 38:693, 1942.

On *Alocasia macrorrhiza* (L.) Schott (Araceae): Taibei, Taiwan (NTU-PPE).

On *Pistia stratiotes* L.: Hainan Province (HMAS 77329).

Cercospora amorphophalli Henn., Hedwigia 41:147, 1902.

On *Amorphophallus rivieri* Durien (Araceae): Pingshan, Sichuan Province (HMAS 77330); Lunan, Yunnan Province (HMAS 12098).

On *Amorphophallus* sp.: Foping, Shaanxi Province (HMAS 77331).

Cercospora araliae-cordatae Hori, Chosen Sakumotsu Byogai Mokuroku (Nakata & Takimoto, A list of crop diseases in Korea) p.31, 1928.

On *Aralia* sp.(Araliaceae): Nanjing, Jiangsu Province (HMAS 77332).

Cercospora arisaemae F. L. Tai, Chinese Bot. Soc. Bul. 2:47, 1936.

On *Arisaema ambigum* Engl.(Araceae): Nanjing, Jiangsu Province (HMAS 06993, Type).

On *Typhoniun divaricatum* (L.) Decne.: Taizhong, Taiwan (NCHUPP-199).

Cercospora asclepiadis Ellis, Amer. Naturalist 16:810, 1882.

Cercospora maculans Pat., Expl. Scien. Tunisie impr. National, p.132, 1897.

On *Asclepias curassavica* L. (Asclepiadaceae): Hangzhou, Zhejiang Province (HMAS 77335).

Cercospora begoniae Hori, Shokubutsu Byogai Kowa, p.181.10th ed. 1916.

On *Begonia argenteo-guttata* Lemoine (Begoniaceae): Jilin, Jilin Province (HMAS 77340).

On *Begonia evansiana* Andr.: Jilin, Jilin Province (HMAS 77341).

On *Begonia* sp.: Nantou, Taiwan (NCHUPP-214); Chengdu, Sichuan Province

(HMAS 77342).

Cercospora bombacis T. K. Goh & W. H. Hsieh, Trans. Mycol. Soc. R.O.C. 2:87, 1987.
On *Bombax malabaricum* DC.(Bombacaceae): Zhanghua, Taiwan (NTU-PPE).
On *Ochroma lagopus* Swartz: Guangzhou, Guangdong Province (HMAS 77343).

Cercospora brachiata Ellis & Everh., Jour. Mycol. 4:5, 1888.
Cercospora amaranti Lobik, Bolezni Rast. (Morbi Plantarum) 17:193, 1928.
On *Amaranthus retroflexus* L.(Amaranthaceae): Beijing (HMAS 77314); Nanjing, Jiangsu Province (HMAS 77315); Shennongjia, Hubei Province (HMAS 47815).
On *Amaranthus tricolor* L.: Jilin, Jilin Province (HMAS 77316); Guangzhou, Guangdong Province (HMAS 12097).
On *Amaranthus* sp.: Beijing (HMAS 77317); Pengxian, Sichuan Province (HMAS 77318).

Cercospora caladii Cooke, Grevillea 8:95, 1879.
On *Colocasia esculenta* (L.) Schott (Araceae): Foping, Shaanxi Province (HMAS 69418).

Cercospora cannae J. K. Bai, X. J. Liu & Y. L. Guo, Acta Mycol. Sinica 3:102, 1984.
On *Canna indica* L.(Cannaceae): Jilin, Jilin Province (HMAS 43710, Type).

Cercospora catalpae Wint., Hedwigia 24:203, 1885, (same in Jour. Mycol. 1:124, 1885).
On *Catalpa ovata* Don. (Bignoniaceae): Nanjing, Jiangsu Province (HMAS 11873).

Cercospora celosiae Syd., Ann. Mycol. 27:430, 1929.
On *Celosia argentea* L. (Amaranthaceae): Yanglou, Hubei Province (HMAS 12104, Type); Hainan Province (HMAS 77319, 77320).
On *Celosia cristata* L.: Beijing (HMAS 11914); Jilin, Jilin Province (HMAS 77321); Zhenping, Henan Province (HMAS 12105); Taiwan (HMAS 04906); Chengdu, Sichuan Province (HMAS 77322).

Cercospora euonymigena Y. L. Guo & Y. Jiang. sp. nov. Fig.2

Maculae amphigenae, orbiculares vel suborbiculares, 1.5-5.5 mm diam., griseo-albae, pallide brunneae vel griseo-agrae. Caespituli amphigeni. Stromata nulla vel sarva, brunnea. Conidiophora solitaria vel 2-14 laxe fasciculata, pallide brunnea vel brunnea, 1-6 geniculata, 1-12 septata, 50.0-493.8 × 3.8-5.6μm. Cicatrices conspicue incrassatae, 2.5-4.0μm latae. Conidia acicularia, hyalina, erecta vel leviter curvata, ad apicem acutata, ad basin truncata, indistincte multiseptata, 52.5-350.0 × 3.1-5.6μm.

Hab. in foliis vivis *Euonymi japonici* L. (Celastraceae): Chengdu, Sichuan Provincia (HMAS 77350, Holotypus).

Leaf spots amphigenous, circular to subcircular, 1.5-5.5 mm wide, confluent, center greyish white, pale brown to greyish black, margin surrounded by a dark brown line on the upper surface, paler on the lower surface. Fruiting amphigenous. Stromata none or small, brown. Conidiophores solitary or 2-14 loosely fasciculate, pale brown to brown, paler towards the apex, irregular in width, straight to curved, rarely branched, 1-6 geniculate, subtruncate at the apex, 1-12 septate, 50.0-493.8 × 3.8-6.5μm. Conidial scars conspicuously thickened, 2.5-4.0μm wide. Conidia acicular, hyaline, straight to slightly curved, acute at the apex, truncate at the base, indistinctly multiseptate, 52.5-350.0 × 3.1-5.6μm.

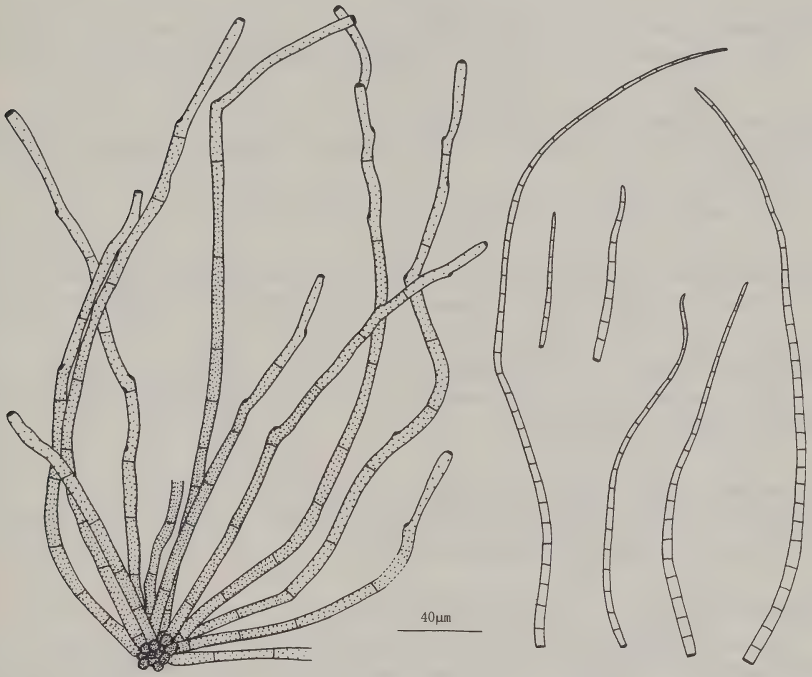

Fig.2 *Cercospora euonymigena* Y. L. Guo & Y. Jiang

Cercospora celastricola Govindu & Thirum. (1954) on *Celastrus paniculatus* Willd. is similar to the new species. It differs from this fungus in possessing larger stromata (30-90μm diam.), darker color (moderately brown to dark brown), shorter and narrower conidiophores (50.0-200.0 × 2.4-4.2μm), and cylindrical to obclavate, shorter and narrower conidia (83.0-116.0 × 2.4-4.2μm).

Cercospora fukushiana (Matsuura) Yamam., Jour. Plant Prot. 14:699, 1927.
Cercospora fukushiana Matsuura, Trans. Tattori Soc. Agr. Sci. Japan 1:83, 1928.

On *Impatiens balsamina* L. (Balsaminaceae): Beijing (HMAS 77336, 77337, 77338); Shenyang, Liaoning Province (HMAS 62018); Jilin, Jilin Province (HMAS 77339); Taibei, Taiwan (NTU-PPE).

On *Impatiens noli-tangere* L.: Foping, Shaanxi Province (HMAS 69429).

Cercospora gomphrenae Ray, Mycologia 36:172, 1944.

On *Gomphrena globosa* L. (Amaranthaceae): Beijing (HMAS 77323); Hankou, Hubei Province (HMAS 77324); Chengdu, Sichuan Province (HMAS 77325).

Cercospora justiciaecola F. L. Tai, Lloydia 11:47, 1948.

On *Justicia* sp. (Acanthaceae): Chengdu, Sichuan Province (HMAS 12127, Type).

Cercospora negundinis Ellis & Everh., Proc. Acad. Nat. Sci. Phila. Part I. 43:89, 1891.

On *Acer davidii* Franch. (Aceraceae): Changsha, Hunan Province (HMAS 77310).

Cercospora olivascens Sacc., Michelia 1:268, 1879.

On *Aristolochia debilis* Sieb. & Zucc.(Araliaceae): Hangzhou, Zhejiang Province (HMAS 77334).

On *Aristolochia* sp.: Shitai, Anhui Province (HMAS 61065).

Cercospora panacicola P. K. Chi & J. K. Pai, Acta Phytotax. Sinica, 10:110, 1965.

On *Panax ginseng* C. A. Mey. (Araliaceae) : Yongji, Jilin Province (HMAS 77333).

Cercospora papayae Hansf., Proc. Linn. Soc. London 1942-43:58, 1943.

On *Carica papaya* L. (Caricaceae): Cheli, Yunnan Province (HMAS 73958); Taizhong, Taiwan (NTUPP-255).

Cercospora sagittariae Ellis & Kell., Jour. Mycol. 2:1, 1886.

On *Sagittaria sagittifolia* L. (Alismataceae): Hangzhou, Zhejiang Province (HMAS 77311); Kaiyuan, Yunnan Province (HMAS 01956).

Cercospora sambuci Y. L. Guo & Y. Jiang sp. nov. Fig.3

Maculae amphigenae, orbiculares vel suborbiculares, 2-8 mm latae, certro griseo-albae, pallide flavo-brunneae vel brunneae, margine griseo-agrae. Caespituli amphigeni. Stromata nulla vel parva. Conidiophora solitaria vel 2-13 fasciculata, modice brunnea, erecta vel curvata, non ramosa, 1-6(-13) geniculata, multiseptata, 42.5-142.5(-400.0) × 3.5-6.3μm. Cicatrices conspicuae incrassatae, 2.5-3.8μm latae. Conidia acicularia, hyalina, erecta vel leviter curvata, ad apicem acutata vel subacuta, ad basim truncata, 5-multiseptata, 37.5-175.0 × 3.1-5.0μm.

Hab. in foliis vivis *Sambucis buergerianae* Blume. (Caprifoliaceae): Yongji, Jilin Provincia (HMAS 77346, Holotypus); *Sambucis javanicae* Reinw.: Hangzhou, Zhejiang Provincia (HMAS 77347).

Leaf spots amphigenous, circular to subcircular, 2-8 mm diam, pale yellowish brown to brown, center greyish white, margin surrounded by a greyish black line on the upper surface, pale yellowish brown to pale greyish brown on the lower surface. Fruiting amphigenous. Stromata none or only a few brown globose cells. Conidiophores solitary or 2-13 in a fascicle, moderately brown, paler and narrower towards the apex, irregular in width, often wide at the base, up to 8 μm wide, straight to curved, not branched, 1-6(-13) geniculate, multiseptate, 42.5-142.5(-400) ×3.5-6.3μm. Conidial scars conspicuously thickened, 2.5-3.8μm wide. Conidia acicular, hyaline, straight to slightly curved, acute to subacute at the apex, truncate at the base, 5-multiseptate, 37.5-175.0 × 3.1-5.0μm.

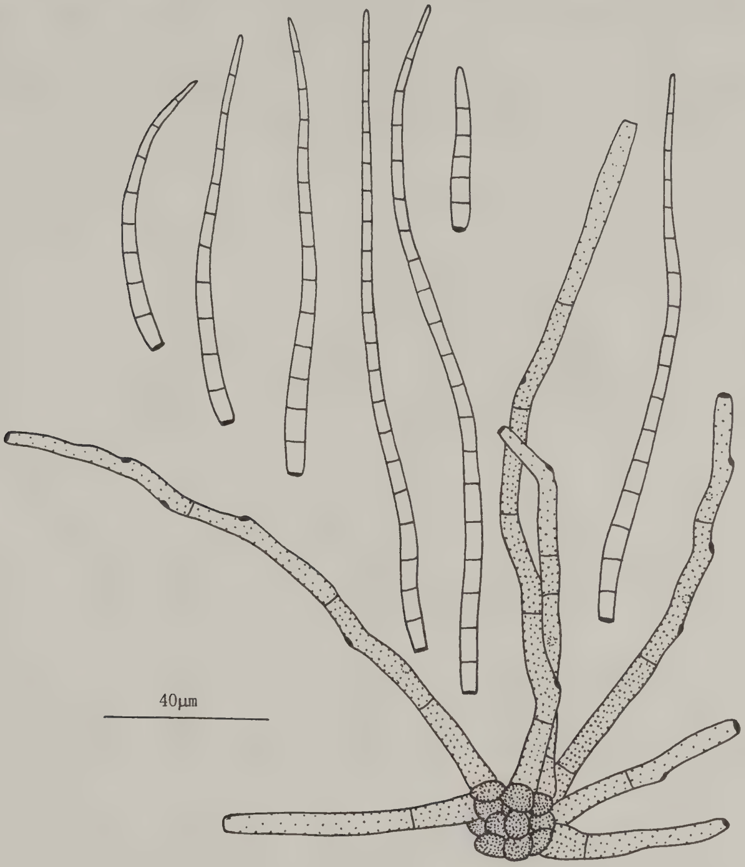

Fig.3 *Cercospora sambuci* Y. L. Guo & Y. Jiang

This fungus on *Sambucus javanica* Reinw., conidiosphores are longer (up to 400.0 μm long and with 13 geniculate) than on the *Sambucus buergeriana* Blume.

Cercospora depazeoides (Desm.) Sacc. (Nuov. Giorn. Bot. Ital. 8:187, 1876) on *Sambucus nigra* L. is similar to the new species. It differs from this fungus in having larger stromata (20-80μm diam.), obclavate to cylindrical-obclavate, pale olivaceous conidia.

This species is different from *Cercospora lateritia* Ellis & Halsted (1888) on *Sambucus pubens* Michx. by the later having effuse fruiting, larger stromata (up to 50 μm diam.), shorter conidiosphores (20-70 μm), and cylindrical to obclavate-cylindrical, hyaline to very pale reddish brown, shorter conidia (20-60 μm).

Cercospora siphocampyli Chupp & Viegas, Bol. Soc. Brasileira Agron. 7:367, 1944.
On *Adenophora* sp. (Campanulaceae): Beijing (HMAS 77344).

Cercospora viburnicola Ray, Mycologia 33:174, 1941.
On *Viburnum* sp. (Cappridiaceae) : Nanjing, Jiangsu Province (HMAS 77348); Liuba, Shaanxi Province (HMAS 69436); Jiangkou, Sichuan Province (HMAS 69437).

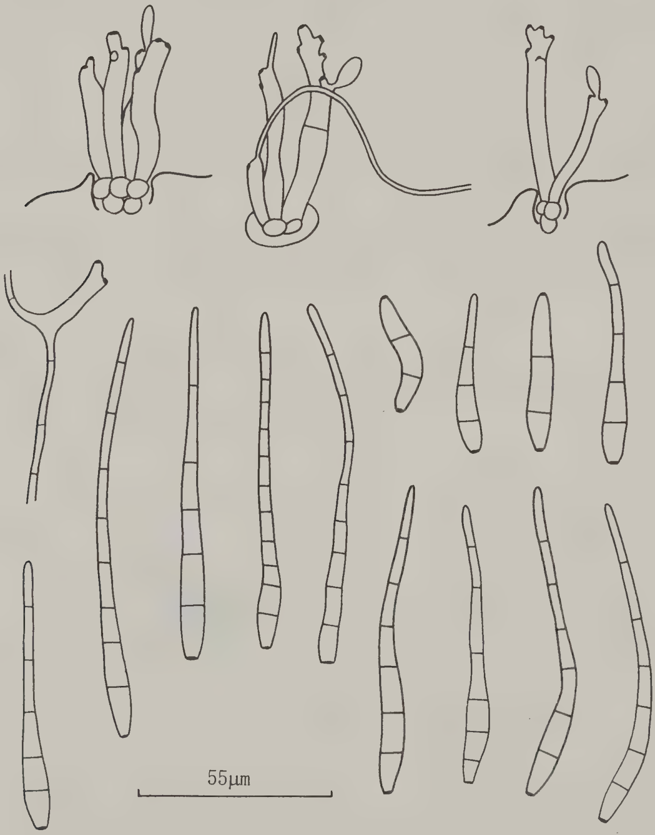

Fig.4 *Mycovellosiella rhoidis* Y. L. Guo

Mycovellosiella rhoidis Y. L. Guo, sp. nov. Fig.4
Maculae amphigenae, suborbiculares, angulares vel irregulares, 1-4 mm latae,

brunneae vel atro-brunneae. Caespituli hypogeni. Mycelium secundarium superficiale: hyphae subhyalinae, ramosae, septatae, 1.7-3.2μm latae. Stromata nulla. Conidiophora ex hyphis mycelii secundarii oriunda vel 2-8 fasciculata, hyalina vel dilutuissime olivacea, non ramosa, erecta vel leviter curvata, 0-1 geniculata, 0-1 septata, 13.0-65.0 × 4.0-7.5μm. Cicatrices conspicuae, 1.7-2.2μm latae. Conidia obclavata, hyalina, solitaria vel interdum catenata, erecta vel curvata, ad apicem acuta vel obtusa, ad basim obconico-truncata, 2-11 septata, 26.0-138.0 × 4.0-6.5μm.

Hab. in foliis vivis *Rhoidis* sp. (Anacardiaceae): Shennongjia, Hubei Provincia, 2 VIII 1984, leg. Y. L. Guo, no. 212 (HMAS 77433, Holotypus).

Leaf spots amphigenous, subcircular, angular to irregular, 1-4 mm diam., often confluent, center brown to dark brown, margin blackish brown on the upper surface, gray to pale grayish brown on the lower surface. Fruiting hypogenous. Secondary mycelium external: hyphae emerging through stomata or formed from the tip of conidiophores, subhyaline, branched, septate, 1.7-3.2μm wide. Stromata none. Conidiophores emerging through stomata, 2-8 fasciculate or borne terminally or laterally on external hyphae, hyaline to very pale olivaceous, not branched, irregular in width, straight to slightly curved, 0-1 geniculate, conical at the apex, 0-1 septate, 13.0-65.0 × 4.0-7.5μm. Conidial scars thickened, 1.7-2.2μm wide. Conidia obclavate, hyaline, solitary or occasionaly catenulate, straight to curved, apex subacute to obtuse, base obconically truncate, 2-11 septate, 26.0-138.0 × 4.0-6.5μm.

The new species differs from *Mycovellosiella rhois* (Sawada & S. Kats.) T. K. Goh & W. H. Hsieh (1987) on *Rhus semialata* Murr. var. *roxburghana* DC. by its indefinite spots, abundant external hyphae, larger stromata (up to 65μm diam.), pale olivaceous brown, branched, narrower conidiophores (70×4-5 μm), and cylindrical, catenulate, shorter and slightly narrower conidia (20-100×4-5 μm).

Pseudocercospora asclepiadina (Speg.) Deighton, Mycol. Pap. 140:22, 1976.
Napicladium asclepidinum Speg., An. Mus. Nat. Hist. nat. B. Aires 22:442, 1910.

On *Asclepias curassavica* L. (Asclepiadaceae): Hangzhou, Zhejiang Province (HMAS 76385).

Pseudocercospora ubicola (Yen) Deighton, Mycol. Pap. 140:155, 1976.
Cercospora ubicola J. M. Yen, Rew. de Mycol. 30:200, 1965.

On *Dioscorea subcalva* Praim & Burk (Dioscoreaceae): Kunming, Yunnan Province (HMAS 04518, 12230, 12231).

ACKNOWLEDGEMENTS

The authors are greatly indebted to Prof. Zhou GS for identification of host plants and to Ms. Zhu XF for inking the drawings.

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MYCOTAXON

Volume LXXIV(2), pp. 267-285 April-June 2000

MYXOMYCETES OF THE WINTER-COLD DESERT IN WESTERN KAZAKHSTAN

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Abstract: During a four-week expedition in April and May 1995, the winter-cold desert of the Mangyschlak Peninsula (52°13' E, 44°01' N) was surveyed for myxomycetes. From about 1,000 substratum samples, 146 moist chamber cultures were prepared. With the intention to check all suitable microhabitats, bark of all common desert shrubs, the rarely occurring accumulations of litter, and dung of various herbivorous animals were collected. For each culture, 5-10 individual samples of 2-3 pieces each were pooled from one microhabitat type. Although only two species with 10 collections were found in the field, the moist chamber cultures revealed a whole flora of desert myxomycetes. Twenty-seven species of myxomycetes, two members of the Protosteliales, and various Myxobacteria were recorded, often with exceedingly high levels of abundance. Among these are numerous species previously considered as rare, including *Echinostelium arboreum*, *E. colliculosum*, and *Macbrideola oblonga*. For rare or taxonomically difficult species, brief taxonomic descriptions are given. Compared with surveys from other geographic regions, the desert flora encountered is rather poor but one of the most distinctive among myxomycetes. In addition to obvious features such as absence of trees and succulent plants or the harsh, arid conditions, the high (7.5-8.0) pH of almost all of the substrata present seems to be a limiting factor.

Key words: biodiversity, desert, myxomycetes, Kazakhstan, microhabitats

INTRODUCTION

The life cycle of Myxomycetes (plasmodial slime moulds) involves two trophic stages, one consisting of uninucleate amoebae and the other represented by a distinctive multinucleate structure, the plasmodium, surrounded by the cell membrane and a slime sheath only. Both feed phagotrophically on bacteria, yeasts, spores of filamentous fungi, algae, and other protists (Stephenson and Stempen 1994). Since both trophic stages require moist, humid conditions, deserts would seem to present an extreme habitat for myxomycetes. Due to the apparent absence of fructifications in the field, desert myxomycetes are indeed poorly known. Nevertheless, some studies point towards a surprisingly rich and distinct myxomycete flora in arid regions (for example Arizona: Evenson 1961, Blackwell & Gilbertson 1980; Gobi desert: Novozhilov & Golubeva 1986).

The present study, made during a journey stretching about 1,500 km, adds a regional flora from one of the world's most extreme habitats - the winter-cold desert region east of the Caspian Sea. The region has a strong continental climate with extremely severe winters, and therefore even succulent plants are absent. Due to the rarity of myxomycete fructifications in the field, the survey presented herein focused almost exclusively on substratum sampling, including all frequently occurring substrata that appeared suitable for myxomycete growth. The region is seemingly not studied; a species account for Kazakhstan (Vasjagina et al. 1977) lists 111 species of myxomycetes, but these records are almost exclusively from montane areas of the country.

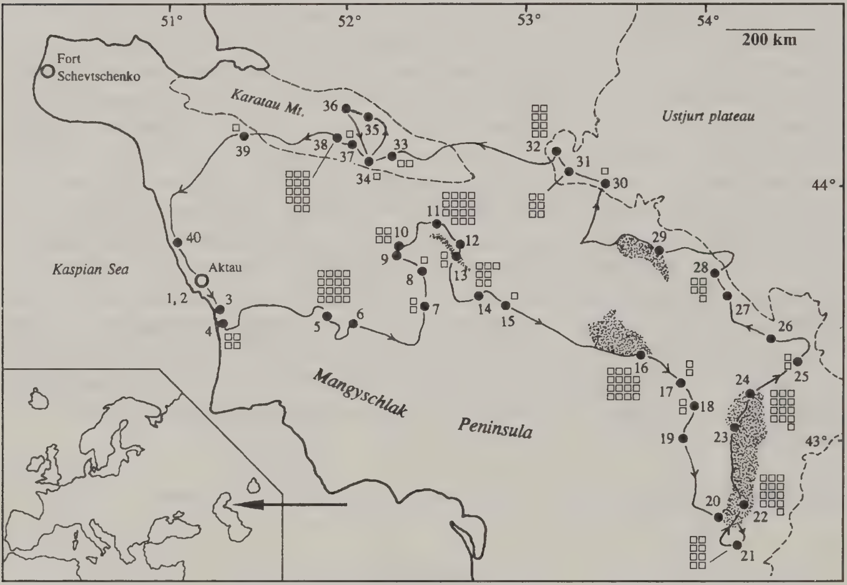
51°
52°
53°
54°
200 km
Fort Schevtschenko
Karatau Mt.
Ustjurt plateau
44°
Kaspian Sea
Aktau
Mangyschlak
Peninsula
43°
1, 2
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Fig. 1 Map of the Mangyschlak Peninsula, showing the journey (line with arrowheads) with collection points indicated. Dotted areas stand for larger sand dunes. Dotted lines mark the western boundary of the Ustjurt Plateau and the range of the Karatau Mountains. Numbers refer to the localities, with sets of quadrates indicating the number of collected substratum samples. Inset: Geographical position of the Mangyschlak region (arrow).

STUDY SITES

The Mangyschlak Peninsula, the area investigated, is naturally limited westwards by the shoreline of the Caspian Sea and eastward by the Ustjurt Plateau. In contrast to the very uniform sagebrush half desert of the Ustjurt Plateau, the desert of the Mangyschlak Peninsula is characterised by a more rugged relief, basically formed by a plateau furrowed by numerous deep depressions and canyons. Stony badlands dominate, harbouring a scanty vegetation of small shrubs and annual plants. With the exception of some planted individuals around artificial wells, larger trees are absent.

Our expedition was a four-week journey, describing a loop of about 1,500 km that began and ended at the town of Aktau (formerly named Schevtschenko). It extended from 51°18' E near Aktau in the west to 54°26' E in the east, touching the vegetation zones of southern feathergrass steppe in the Karatau Mountains, sagebrush desert in the central part, and southern desert dominated by *Chenopodiaceae* (Anonymous 1990). Fig. 1 shows the journey with the 40 localities investigated. The Mangyschlak Peninsula can be characterised as one of the harshest landscapes on Earth. Due to the extreme temperatures during the winter (up to -40 °C, with an average January temperature around -10 °C), no succulent or evergreen plants occur. The mean annual precipitation is 177 mm, with a monthly maximum of about 30 mm in August and September. Winter snowfalls are rare and are in some years absent. Considering the strong wind-chill, subterranean parts of wintering plants suffer from extremely low temperatures. Humid conditions with temperatures above 0 °C last for only about 1-2 weeks in spring and another 3-4 weeks in autumn. In spring, the temperature rises rapidly, soon changing into hot and very dry summer weather. Strong winds are typical, often producing dust storms at dawn, bringing hot air from Central Asia (Afghanistan). Remarkable were the high fluctuations in air humidity during our journey (which extended from the beginning to the end of spring), ranging from 100 % during nightly dew fall to less than 10 % around noon. In spite of the harsh conditions, the vascular plant flora is relatively rich (about 600 species). However, about 25 % of all plant species are annuals, living actively only during the short springtime (Safronova 1992). Only about 30 species of plants are higher shrubs (maximum height 1-2 m, in sand dune areas up to 3.5 m). The human influence on the vegetation is low, basically consisting of grazing by camels, horses and sheep. Small rodents occur with high population densities; among these are *Citellus citellus*, *C. fulvus* and mice of the genus *Meriones* (names after Gromova & Baranovoj [1981]). Due to hunting, the indigenous Saiga antelope (*Saiga tatarica*) is rare and often displaced by free roaming sheep.

Except for the Karatau Mountains, the whole region is derived from marine, basic sediment stones, mostly layers of dolomitic limestone, various kinds of calcareous marl, chalk and sandstone, often forming cliffs and rocky reefs. The soils are basic, with pH values mostly between 7.5 and 8.0. Huge areas are salt pans or are covered by sand dunes (Fig. 1). Only the Karatau Mountains are built from acidic slates. Due to the edaphic conditions often changing over short distances, various plant associations have been recognised (Safronova 1991a, b). As described below, five main habitats can be differentiated (nomenclature for vascular plants follows Czerepanov [1995]).

1. The **plateau**: The most uniform landscape, with elevations between 200 and 300 m. Loamy, very solidified soils support a poor vegetation of mainly sagebrush (*Artemisia* spp.), rarely intermixed with taller perennials such as *Rheum tataricum*. The investigated western part has slightly higher rainfall and harbours a flora richer in shrub-forming

species. Shrubs are up to 70 cm tall and usually have a deeply furrowed, or less commonly a peeling bark. Of interest as myxomycete substrata are a number of common *Chenopodiaceae* (*Salsola* spp., *Haloxylon aphyllum*) as well as *Atraphaxis replicata*, *Convolvulus fruticosus*, or *Astragalus karakugensis*, the latter remarkable by possessing a fibrous bark with high water retention.

2. **Cliffs, gorges and rocky reefs**: Gigantic dry depressions and canyons interrupt the plateau, often with scenic cliffs dropping off 100-200 m. The deepest of these depressions (Karagia) lies 132 m below sea level. Exposed to the fogs from the Caspian Sea, the cliff edges house plant communities significantly richer in species. Here *Rhamnus sintenisii*, an endemic of the region, can be found, forming taller shrubs up to 3 m height. This is the only common plant providing noticeable amounts of leafy litter. Other shrubs have mostly tiny to scale-like leaves and green, assimilating twigs. The soils are stony, calcareous and not too salty.

3. **Salt swamps and pans**: At the bottom of the depressions, gypsum or very salty soils dominate; frequently, salt pans (solontschaks) without any vegetation occur. The prevailing shrubs are various species of *Tamarix*, more rarely *Halostachys caspica*. Exceptional was the Ukere salt spring in the southern desert; at this site a short salty rivulet drains into a salt swamp.

4. **Sand dunes**: Smaller and larger sand dune areas with a very different vegetation are scattered throughout the region. Shrubs, such as *Haloxylon aphyllum* and various species of *Calligonum*, accompanied by two larger species of *Astragalus,* dominate. Very conspicuous are the big umbrellas of *Ferula foetida*, a giant member of the Apiaceae family with a life history similar to the century plants (*Agave*) found in New World deserts. In general, the vegetation on sandy soils is richer and more dense, locally providing thin mats of twiglet litter under the shrubs.

5. **Karatau Mountains**: Shallow hills with moderate elevations between 350 and 450 m are interrupted by deep-cut valleys. The soils are rocky to stony, often with rubblefields of acidic slate. Only here fresh water was present in small rivulets, usually framed by dense thickets of *Mentha longifolia*. The northern valley slopes bear feathergrass steppes poor in shrubs, with the southern counterparts being dominated by sagebrush. In the valleys, larger shrubs and *Crataegus ambigua*, the only naturally occurring tree, can be found.

MATERIALS AND METHODS

Substratum samples were collected systematically from all major shrub species, plant refuse and animal dung – all organic matter considered suitable for myxomycetes – at 40 locations during the journey. The field work was carried out in late April and early May of 1995, which represented the end of the short spring season. The first days were still cold and cloudy, with occasional brief rainfalls; the last days were already very hot, often with dust storms in early morning.

For substratum sampling, within a sample plot typically covering 500-1,000 square meters, the vegetation was recorded (abundance and coverage of the dominant vascular plants, vegetation structure, and soil features). Substrata were collected in 2-3 pieces from 5-10 plant individuals or points within the plot that shared the same microhabitat features. These were pooled, yielding a total sample of 15-35 g weight. Sampling included (i) for all larger shrubs or trees, the non-living outer part of the bark as scales of 1-2 cm size, (ii) thin mats of litter at the base of trees or tussock-forming plants, and (iii) droppings of herbivorous animals, mostly rodents. For each sample, microclimatic conditions such as height, light, wind exposure as well as substratum features (texture, moisture, and degree of decay) were recorded for later ecological investigations (Schnittler, in prep.). A total of 146 samples was collected, including bark (81 samples), litter (35) and animal dung (30). The moist chamber cultures were prepared in the manner described by Härkönen (1977). For moist chambers, substratum pieces were placed on filter paper in Petri dishes, with the pieces touching but not overlapping each other and with the outer side of bark upside. Destilled water adjusted to pH 7.0 was added to each culture. All cultures were maintained 2 months under diffuse daylight and at room temperature (22-23 °C). On five occasions (days 2, 6, 11, 21 and 40 after start) the chambers were checked with a high-magnification dissecting microscope. Mature fructifications were mounted in small boxes, and sporocarps of minute species were immediately preserved in polyvinyl lactophenol or glycerol gelatine, when calcareous structures were present. From the 513 fructifications recorded, 169 specimens were collected and stored in the private collection of the first author at the Herbarium Haussknecht, Jena (JE). In addition, duplicates of some species were deposited at the Herbarium of the Komarov Botanical Institute, St. Petersburg (LE).

For comparison of myxomycete floras from different parts of the world, species lists of the respective papers were databased. From a synoptic table of all records, the coefficient of community indices (see Stephenson et al. 1993) were calculated. These have a value between 0 (nothing in common) and 1 (all species are members of both floras).

ANNOTATED SPECIES LIST

The following list includes all recorded species in alphabetical order. Nomenclature essentially follows Martin & Alexopoulos (1969), but for species not mentioned in this monograph, a reference to the protologue is given. Determinations considered as doubtful are given with the note 'cf.' (confer). Bold symbols in parentheses represent an abundance estimation of each species using the percentage scale of Stephenson et al. (1993), based on the proportion of a species in the total number of records (513): R - rare (≤0.5 %), recorded once or twice; O - occasional (0.5-1.5 %), 3-6 records; C - common (1.5-3 %), 7-11 records; A - abundant (>3 %), more than 11 records. After a comma, the number of collections follows, separated by a colon from the locality numbers as referred to in Fig. 1. Short comments on habitats and distribution are included; for rare and/or taxonomically difficult species, brief taxonomic descriptions are given. Colours are described as observed with a dissecting microscope and as seen by transmitted light. For the latter, the degree of transparency is described as: translucent - glass-clear; transparent - allowing milky light to come through, colours are visible; and opaque - impermeable to light, the structure appears black. Spore measurements are given for specimens mounted in polyvinyl lactophenol. Therefore, diameters can be slightly smaller (0-3 %) than for fresh material investigated in water. Terms for taxonomic descriptions are as used in Lado & Pando (1997), with colours described according to Kornerup & Wanscher (1981).

Although 40 localities where checked in the field for myxomycete fructifications, only for those mentioned in the following list were myxomycetes recorded. Except for the field collections obtained at localities 15 (*Physarum notabile*) and 33 (*Didymium squamulosum*), all records are from substratum samples cultivated in moist chambers. Locality numbers refer to Fig. 1.

4: sand dunes ca. 25 km SE Aktau, on the northern edge of the solontschak Karanol, near the Caspian Sea, 51°18'25" N 43°28'49" E ± 1 km
5: stony ground over limestone, near the upper edge of a cliff ca. 1 km NW of the well Sauttuy, E margin of the depression Karagije, elevation 110 ± 20 m, 51°52'37" N 43°31'23" E ± 1 km
7: sandy to loamy gypsum soils near the eastern margin of the depression Karagije, plateau on the NE edge of the depression Korganoi, 160 ± 20 m, 51°26'36" N 43°34'11" E ± 200 m
10: overgrazed and devastated sandy soil near the Karasasschokui Mt., next to the buildings of a Kazakh cemetery, 52°17'42" N 43°47'12" E ± 400 m
11: stony ground (limestone and chalk), plateau ca. 2 km N of the Baskuduk sand dunes, on the margin of giant chalk cliffs falling up to a depression, 52°28'51" N 43°52'39" E ± 200 m
13: loose, deep-grounded, sandy soil, at the NE margin of the Baskuduk sand dunes, 180 ± 20 m, 52°36'08" N 43°49'19" E ± 500 m
14: loose, deep-grounded, slightly overgrazed, sandy soil in a small valley between cliff edges, NW margin of the depression Usen, 240 ± 20 m, 52°44'09" N 43°33'46" E ± 600 m
15: stony soil between limestone plates, margin of the plateau to the depression Usen, NE-edge, 240 ± 20 m, 52°50'40" N 43°33'21" E ± 150 m
16: deep-grounded, loose soil, margin of the Tjuesu sand dunes, SE-edge, near the margin of a solontschak, ca. 2 km N of the well Besoktui, 80 ± 20 m, 52°36'53" N 43°21'07" E ± 500 m
17: solid, somewhat loamy soil between sandstone slates ca. 5 km N Mt. (cliffs) Kunabai, small sandstone hills, 120 ± 20 m, 52°48'49" N 43°13'53" E ± 100 m
18: solid, stony soil with marl, above limestone rocks, slightly overgrazed, ca. 10 km SSE Mt. Kunabai, on the plateau margin, 160 ± 20 m, 52°53'00" N 43°06'27" E ± 200 m
21: deep-grounded gypsum soil with earth lichens, small valley of the creek from the salt spring Ukere, SW-edge of the Ustjurt Plateau, 10 ± 20 m, 54°09'12" N 43°36'38" E ± 500 m
22: solid but sandy soil near a well, overgrazed, on the W margin of the Karünjarük sand dunes, SW-edge, ca. 5 km N of the well Seksorka, 90 ± 20 m, 54°08'50" N 43°46'25" E ± 5 km
24: loose sand dunes above red sandstone hills up to 50 m, Karaschek Mts. in the NW-part of the Karünjarük sand dunes, 140 ± 40 m, 54°11'23" N 43°10'37" E ± 1 km
25: solid, sandy soil on the bottom of a depression at the northernmost margin of the Karünjarük sand dunes under the cliffs to the plateau, 40 ± 20 m, 54°26'14" N 43°20'06" E ± 500 m
28: loose, sandy soil between sandstone boulders, terasses of a cliff slope forming the Kolbai Mts., W margin of the Ustjurt Plateau, 140 ± 40 m, 53°59'18" N 43°41'23" E ± 400 m
30: stony soils above chalk rocks, cliff valley in the Ustjurt Plateau at the NE edge of the Tusbair salt lake ca. 1 km SSE of the well Sandui, 53°27'39" N 44°01'22" E ± 600 m
31: stony soil above limestone rocks, near a cliff delimiting the Ustjurt Plateau, near the well Monata, 250 ± 20 m, 53°12'32" N 44°06'11" E ± 600 m
32: stony soil above limestone, cliffs delimiting the Ustjurt Plateau, falling down to the Kaidak salt lake, ca. 2 km NE of the spring Okbai, 240 ± 20 m, 53°3'35" N 44°10'25" E ± 1 km
33: stony soil above Devonian slate, ca. 12 km E Schetpe, hills on the N margin of the eastern Karatau Mts., 260 ± 40 m, 52°16'28" N 44°08'41" E ± 2 km
34: stony ground on the bottom of a deep-cut rivulet canyon ca. 4 km SW Scharmüsch, N margin of the eastern Karatau Mts., 160 ± 40 m, 52°25'19" N 44°07'59" E ± 1 km
37: sandy, overgrazed soil ca. 5.5 km NW Schetpe, foothills at the E margin of the Karatau Mts., near a well, 200 ± 50 m, 52°04'58" N 44°10'45" E ± 400 m
38: shallow, somewhat sandy soil above Devonian slate, deep-cut rivulet valley ca. 16 km NW Schetpe, western Karatau Mts., 180 ± 40 m, 51°57'31" N 44°14'20" E ± 1 km
39: stony soil between plates of limestone rocks, cliff edge ca. 7 km SW Danüspan Mt., southern foothills of the Karatau Mts., 160 ± 20 m, 51°21'57" N 44°15'19" E ± 100 m

Arcyria minuta Buchet (**R**, 1: loc. 4). Once on bark of *Tamarix*, sand dunes near the Caspian Sea.

Comatricha laxa Rostaf. (**O**, 4: loc. 4, 38). Four records, bark of *Tamarix* and *Crataegus* in areas with higher moisture (coast and Karatau Mountains).
Small groups of always single, scattered sporocarps (0.35)-0.5-0.8-(1) mm tall, relatively long stalked, stalks reaching one to one and a half times the sporotheca diameter. Sporotheca globose to weakly ovoid in larger sporocarps, (0.15)-0.2-0.3-(0.35) mm in diameter, dark blackish brown (6F8). Stalk fibrous, especially at the base, with an inconspicuous hypothallus lacking any reddish tints, under the microscope opaque, black, turning to olivaceous-yellow (4B6) at the base, (0.2)-0.3-0.5-(0.6) mm high, extending into a columella equalling one to two thirds of the height of the sporotheca. Capillitium stiff and coarse, branching from the whole length of the columella, dark black to brown (6F8-6D6), outer threads pale brown (6D6-6C5), forming in most except very small sporocarps an incomplete surface net with meshes of (6)-10-30-(50) μm, mostly between 10 and 15 μm diameter. Peridium absent, no conspicuous collar. Spores dull olivaceous brown (5E8) in mass, lacking reddish tints, globose, olivaceous brown (5D5) under transmitted light, with regularly arranged warts up to 0.2 mm high, (10)-11-12.7-(13) μm in diameter. Seemingly a common species in arid regions (unpublished observations from Big Bend, Texas, and the Caspian basin around Astrachan) with a habit as pictured in Mitchell (1999, specimens DWM 5423, Tanzania), whereas the drawing in Nannenga-Bremekamp (1991) seems to depict the wood-inhabiting form with larger, ovoid sporocarps and a more lax capillitium.

Comatricha pulchella (C. Bab.) Rostaf. (**C**, 6: loc. 4, 16, 21, 24, 34, 38). Preferentially on bark of *Tamarix* (3 of 6 records) but occasionally on litter; scattered over the whole area investigated.

Didymium anellus agg. (**A**, 25: loc. 4, 5, 7, 10, 11, 14, 16, 17, 21, 22, 24, 31, 32, 38). Common throughout the journey on all kinds of substrata, including the dung of various animals. All fructifications are sessile on a broad or constricted base, ranging from half-globose to flattened sporocarps and plasmodiocarps. Three forms, one regarded as an separate species, could be differentiated.
Didymium anellus Morgan, a form with small lime crystals. Small, scattered sporocarps of 0.25-0.4 mm diameter and up to 0.2 mm high, less commonly short plasmodiocarps, sessile on a dark, sharply constricted base, globose to depressed-globose. Hypothallus a small, brownish disk under the sporocarp, inconspicuous. Peridium black to dull brown (4F7) at the base, here often without lime, in the upper part densely sprinkled with isolated lime crystals, these easily differentiated under a dissecting microscope but relatively small, one half or equal the spore size. Peridium translucent, colourless to pale brownish (4A2-4B2) under transmitted light. Capillitium consisting of colourless to pale brownish (5A2-5D5) threads, 1-2-(2.5) μm wide, often branching and anastomosing to form an incomplete network, sometimes with flattened and darker coloured sections on the branches. Spores dull brown (5F6) in mass, under the microscope olive brown (7D4), globose, regularly covered with warts up to 0.5 μm high, (9.2)-9.6-10.5-(11.5) μm. This form best fits the description of *Didymium anellus*, except for the slightly larger spores (described as 7-10 μm in diameter).

Didymium anellus, a form with large lime crystals. Differing by the mostly short plasmodiocarps, sessile on a constricted base; lime crystals on the peridium very scattered, large and well developed, mostly 2-3 times larger than spores; the spores larger and slightly paler, (9.5)-10.5-11.5-(12.5) µm in diameter, warts smaller, and more densely arranged.

Didymium inconspicuum Nann.-Bremek. & D.W. Mitch. (Nannenga-Bremekamp, 1989). Small and inconspicuous, scattered sporocarps and short plasmodiocarps of 0.25-0.4 mm diameter, up to 0.1 mm high, less commonly short plasmodiocarps, flattened and sessile on a broad base. Hypothallus not detectable. Sporocarps grey to ochraceous (5B2-5B3), evenly sprinkled with very small, coalescing lime crystals, these much smaller than the spores, 3-6 µm in diameter and difficult to differentiate under a dissecting microscope, often forming a thin crust. Peridium translucent and pale colourless to yellowish-brown (4A2-4B3) under transmitted light. Capillitium formed by colourless to pale brown (5A2-5D5) threads, 1-2-(2.5) µm wide, often branching and anastomosing to an incomplete network, sometimes with flattened and darker coloured sections on the branches. Spores dull brown (5F6) in mass, under the microscope pale olive brown (7C3-7D4), globose, regularly covered with very fine and dense warts up to 0.3 µm high, (9.5)-10.5-11.5-(12.5) µm in diameter. As compared with isotype material (coll. Mitchell, DWM 4430), the Kazakh specimens seem to be identical with *D. inconspicuum*, described from one moist chamber culture prepared with bark from an unidentified desert shrub in Arizona.

Didymium annulisporum H.W. Keller & Schokn. 1989 (**R**, 1: loc. 24) Once on sheep dung, pH 8.2.

Very small, scattered globose sporocarps of (0.1)-0.15-0.2-(0.25) mm, sessile on a slightly constricted base. Hypothallus pale white to straw-coloured (4B4-4B7), limeless except for some lime granules in the centre. Sporothecae ash-grey (4B1) to white, densely covered with fine, star-like lime crystals touching each other with their tips. In contrast to *Didymium difforme*, individual lime crystals are still recognisable under a dissecting microscope; the crystals forming a brittle crust. Peridium colourless under transmitted light, smooth or minutely roughened. Capillitium consisting of colourless and slender threads arising from the base of the sporocarp, rarely branching and anastomosing, mostly with free ends, some reaching the peridium and connected with it, 1-1.2 µm wide. Spores dark brown (7F8 and darker) to almost black in mass, globose to slightly lemon-shaped under the microscope, pale violet grey (8D3) with conspicuous, scattered blunt and very dark spines up to 1.2 mm in length, with a darker, thin but conspicuous germination slit surrounding the spore like a belt, 12-13-(13.5) µm in diameter. Our specimen fits the excellent original description perfectly, except for the larger spores, which are described as 10-11 µm in size.

Didymium difforme (Pers.) S.F. Gray (**C**, 12: loc. 5, 7, 11, 14, 18, 22, 25, 28, 31, 32, 38). Surprising was the occurrence of this usually litter-inhabiting species on bark, especially *Rhamnus* (4 records). Localities are scattered over the whole region, except near the coast.

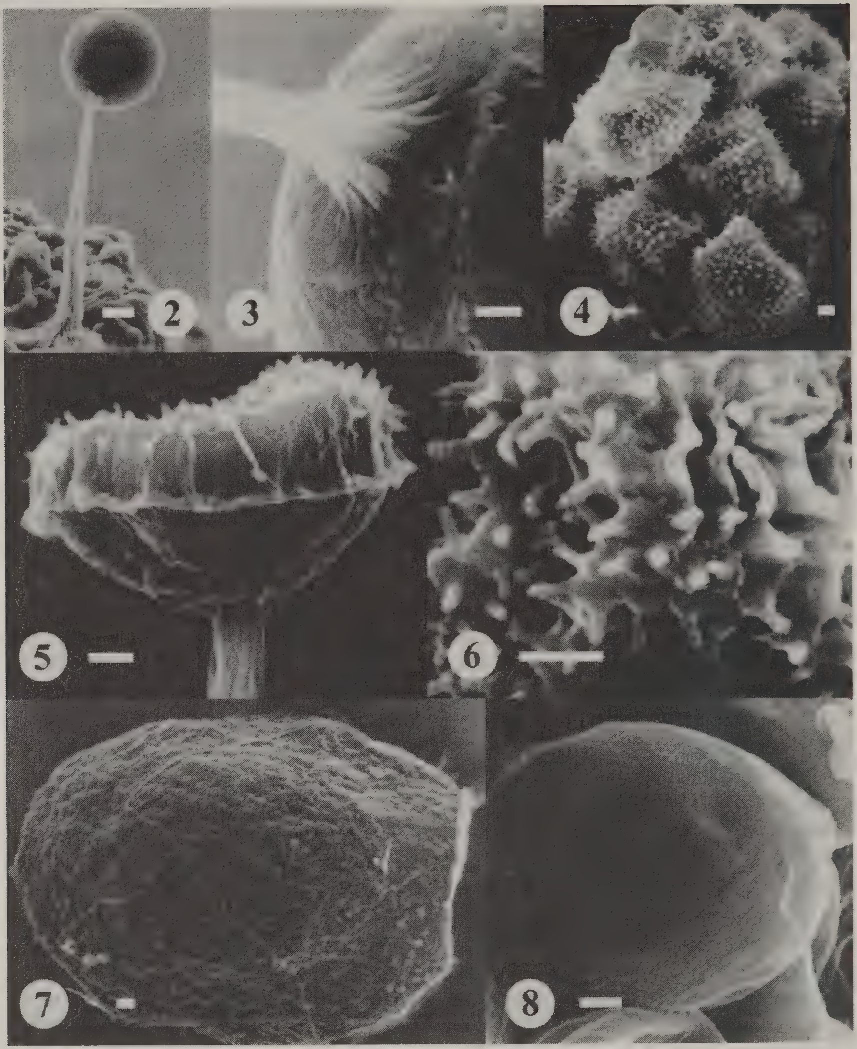
Didymium squamulosum (Alb. & Schwein.) Fr. (**R**, 3 + 8 field collections: loc. 25, 38). Except for two records on dung, the usually common species was found only in the Karatau Mountains within dense thickets of *Mentha longifolia* in a creek. Fresh sporocarps were abundant on dead stems protruding the water. Perhaps due to the extremely dry air, only a small zone of about 2 cm above the water surface was suitable for myxomycete growth. As indicated also by other findings (Kappel 1992), this species seems to be able to develop in water, thus not requiring extensive amounts of moist substratum.

Echinostelium arboreum H.W. Keller & T.E. Brooks, 1976 (**A**, 16: loc. 5, 11, 14, 16, 17, 22, 24, 32, 38)
Exclusively on the bark of various desert shrubs; throughout the region except near the coast.
Small to large colonies of single sporocarps, stout in habit, stalked, yellow-brown (4B4-4B5). Sporothecae urn-shaped, 30-50 μm in diameter. Stalk 120-150 μm long, in transmitted light yellow (4A4) to pale ochraceous (4B4) in the lower section, about two thirds of length filled with darker granules, diameter 10-15 μm on base, tapering to 2.5-3.5 μm on top. Peridium often persistent, smooth and colourless in transmitted light, leaving at least a conspicuous collar. No particular dehiscence lines were visible, but sutures during sporocarp development allowed the peridium, usually not connected with the capillitial threads, to fall away in mature sporocarps. Capillitium arising from one point at the centre of the sporotheca with a few perpendicular, stiff branches, these mostly dichotomous 1(-2) times more forked, at the ends about 1 μm in diameter. Spores in mass rose (4B4) to olivaceous (5B4) brown, very pale olivaceous (4A3) under the microscope, globose, ornamented with flat, patchy, slightly darker warts of 1-1.2 μm diameter, (5.5)-6.5-8-(9) μm in size.

Echinostelium colliculosum K.D. Whitney & H.W. Keller, 1980 (**A**, 45: loc. 4, 5, 10, 11, 13, 14, 16, 17, 18, 21, 22, 24, 28, 37, 38), Figs. 2-6. With high preference for bark, only exceptionally occurring on litter.
Large colonies of single but gregarious sporocarps, pink (7B2) to colourless, fresh shining like a small brilliant brooch, (50)-60-100 μm in height, each with 40-100 spores. Stalk white, colourless and translucent under the microscope, filled with a few dirt granules in the lower third, (40)-50-70 μm in height, diameter about 10 μm at the base, 2-2.5 μm on top. Peridium fugacious, collar absent. Columella consisting of a single, spore-like cell attached on the top of the stalk, with the same diameter and ornamentation as the spores. Spores white in mass, seldom very pale pink (7A2), colourless under the light microscope, globose, almost smooth but with large, thickened patches (articular surfaces) of unequal size, spore wall often shrinking on the smaller, thinner areas, (7)-8-9.5-(10.5) μm in size. Astonishingly, the spores appearing smooth under the compound microscope show small spines when viewed by SEM (Figs. 4, 6). The solid clusters of spores with not sharply separated articular surfaces very different in size within a spore as well as the longer stalks exclude the similar *E. coelocephalum* T.E. Brooks & H.W. Keller (Keller & Brooks 1976).

Echinostelium minutum de Bary (**O**, 3: loc. 4, 22, 38). Probably not belonging to the regular desert flora. The single record consisting of a large colony was from the bark of *Salix alba* planted around an artificial well.

Fuligo cinerea (Schwein.) Morgan (**R**, 2: loc. 5, 11).
Fructifications arranged in colonies of heaped plasmodiocarps, bent brain-like and coalescing into an aethalium of irregular shape and (3)-5-10 mm size, sessile on a broad



Figs. 2-8 SEM photographs of *Echinostelium colliculosum* (2-6, Schnittler 6791) and *Licea* spec. (7-8, 6856). 2 Developing sporocarp, still with a closed peridium; bar = 10 μm. 3 Detail of a later developmental phase, showing the columella as a ring differentiated from the still homogenous plasma mass. 4 Mature spores. 5 Tip of stalk with a spore-like columella; the horizontal ring marks the position of the peridium present in early development. 6 Detail of spore ornamentation; all bars = 1 μm. 7 Closed sporocarp of *Licea* spec.; the lines crossing the sporocarp are contaminant fungal hyphae; bar = 10 μm. 8 Completely smooth spore; bar = 1 μm. Photos Y. Novozhilov.

base and a white hypothallus containing lime granules. Peridium persistent, white to pale lilac (18A2-18A4) when fresh, densely covered with coalescing, thick lime patches, translucent and colourless under the microscope, smooth. Capillitium a network of translucent, colourless threads of 1-4 μm width, with irregular to elongate white lime nodes of 30-80(-100) μm size, filled with amorphous, conglomerated and colourless granula. Spores in mass dark-brown (7F8), ellipsoid to subglobose, pale brown (6C4-6D5) under transmitted light, ornamented with regular distributed to scattered spine-like warts up to 0.8 μm height, (10)-10.5-11.2-(12) μm. Our taxon is probably the small form with a gyrose cortex (approaching *Physarum gyrosum* Rostaf. in shape), as mentioned for 'warm regions' in Martin & Alexopoulos (1969: 264).

Licea biforis Morgan (**R**, 1: loc. 21). Occurring once on *Tamarix* bark from the southernmost locality of the journey.

Licea denudescens H.W. Keller & T.E. Brooks, 1977 (**R**, 2: loc. 13, 38). On leaves and twiglets of *Crataegus* and the bark of *Calligonum.*

Licea kleistobolus G.W. Martin (**A**, 21: loc. 4, 5, 10, 11, 14, 21, 22, 24, 32). The only abundant *Licea*, inhabiting bark of a wide range of desert scrubs.

Licea spec. (**R**, 1: loc. 24), Figs. 7-8. One specimen obtained in culture from rodent droppings (*Citellus* spec.).
Small, densely arranged fructifications of irregular shape, developing from the segregation of one larger plasmodium, of all sizes ranging from *Licea*-like sporocarps of 0.1 mm diameter to short, angular plasmodiocarps up to 0.5 mm size, flattened to half-ovoid, sessile on a broad base. Hypothallus separate for each fructification, slightly broader than these, with the same features as the peridium. Peridium olivaceous brown (5E6-5E7) due to the colour of spore mass, in transmitted light translucent to bright amber (4A6), densely encrusted with small granules and angular crystals of 2.5-5 μm length, densely and very fine warted. Capillitium absent, but very rare short, irregular winded golden yellow (4B8) threads were seen in the microscope, these 2.5-4 μm in diameter, 10-20 μm in length, free, evenly covered with fine warts. Spores in mass pale chestnut brown (5D6), amber (4A6-4B6) in transmitted light, smooth, globose, (9.2)-9.6-10-(10.5) μm, not conspicuous thick-walled.
Licea retiformis Nawawi (1973) fits our specimen except the presence of small capillitium pieces and the non-reticulate shape of the plasmodiocarps. *Perichaena brevifila* H.W. Keller & T.E. Brooks (1971) differs by having very large, conspicuously spiny spores. *Arcyodes luteola* (Kowalski) Nann.-Bremek. (1985) has similar, slightly larger spores, but is described as having a non-ornamented capillitium; *Arcyodes incarnata* (Alb. & Schwein.) Cooke usually has an abundant capillitium and forms crowded to heaped sporocarps without yellowish tints. *Perichaena liceoides* Rostaf., as redescribed in Gilert (1990), differs in having densely ornamented spores and smooth capillitium threads. From habit, *Licea tenera* Jahn (1919) comes closest to our specimen, but differs by having spinulose spores.

Macbrideola oblonga Pando & Lado, 1988 (**A**, 25: loc. 4, 5, 11, 16, 17, 18, 22, 24, 28, 32, 38). Found throughout the journey, occurring exclusively on bark.
Small groups of always single, scattered sporocarps, relatively short stalked, (0.4)-0.5-0.75-(1) mm tall, stalks reaching one fifth to one third the size of the reddish-brown, (8E7) ovoid, seldom globose sporotheca that is (0.35)-0.4.-0.65-(0.7) mm in height. Stalk hollow, not fibrous at the base, emerging from a membranous, discoid hypothallus, translucent pale to dull reddish brown (8C6-8E8) under the microscope, stalk itself dull reddish brown (8E8), transparent, (0.08)-0.1-0.12-(0.2) mm high, thick and stout, on the base 50-100 μm in diameter, often still 30 μm in the centre of the sporotheca. Capillitium stiff and coarse, main branches mostly perpendicular, arising over the whole length of columella, dull reddish brown (8E8), outer threads paler (8B5), branching especially near the surface and ending with pointed spines. Surface net absent. Peridium absent, also no conspicuous collar. Spores reddish brown (8E8) in mass, globose, pale reddish olivaceous brown (8D4) under transmitted light, with very fine, regularly arranged warts up to 0.2 μm high, (8.5)-9.2-10.5-(11.5) μm in diameter.
This taxon matches a description given by Nannenga-Bremekamp & Yamamoto (1983) for a *Macbrideola*, described also by Eliasson et al. (1988) as a *Comatricha*. Comparison with material obtained from Spain (D. Wrigley de Basanta, Madrid, DWB 1372) led to a clear assignment of the Kazakh specimens to *M. oblonga*, previously known only from the Mediterranean area.

Perichaena liceoides Rostaf. emend Gilert, 1990 (**R**, 1: loc. 16). One, larger collection from the bark of *Calligonum densum*, pH 7.6.
Very small, scattered sporocarps without a common hypothallus, globose in shape, (0.1)-0.2-0.4-(0.6) mm in size, sessile on a restricted base and without a visible hypothallus, up to 0.3 mm tall, always rounded in outline. Peridium yellow (4A8) to olivaceous (4B8), with irregularly distributed large black areas, dehiscence line invisible. The membranous layer under transmitted light pale yellow (4A5-4A6), almost smooth, sometimes with paler strips, the duller, opaque patches covered with dull-brown (4C7), rounded inclusions, these 2.5-4 μm in size and densely baked together. Capillitium absent except a few, short outgrowths from the peridium, these wrinkled, 2-3-(3.5) μm wide threads, irregular in shape, pale yellow (4A5) to ochraceous (4B5) and up to 25 μm long. Spores in mass bright golden yellow (4A8), pale yellow (4A5) to ochraceous (4B5) under the microscope, globose, ornamented with conspicuous, scattered and blunt to capitate conspicuous spines up to 1.5 μm in height, (10.5)-11-13.5-(16) μm in diameter. The small, yellow sporocarps lying on the substratum like small eggs are very distinctive.

Perichaena corticalis (Batsch) Rostaf. (**A**, 15: loc. 4, 5, 10, 16, 22, 24, 28, 31, 32, 38). Throughout the region on bark of various desert scrubs, only occasionally found on litter.

Perichaena depressa Libert (**C**, 6: loc. 11, 37, 38). Rarer than the previous species, only recorded from the Karatau Mountains and one locality nearby.

Perichaena vermicularis (Schwein.) Rostaf. (**A**, 42: loc. 4, 5, 10, 11, 13, 14, 15, 16, 17, 18, 21, 22, 24, 31, 32, 33, 38). In spite of the regular occurrence of this species on both bark and litter, only the litter form with a membranous, thin peridium and abundant capillitium was seen.

Physarum cinereum (Batsch) Pers. (**R**, 1: loc. 38). Only once in the Karatau Mountains, on litter of *Mentha longifolia*.

Physarum cf. *confertum* T. Macbr. (**C**, 6: loc. 5, 7, 18, 22). On the bark of various shrubs; found only in the southern part of the journey.
Fructifications in small colonies of scattered, short plasmodiocarps, sometimes coalescing, all sessile on a inconspicuous hypothallus. Plasmodiocarps worm-like, often forming annulate rings, globose in cross-section and ca. 0.3 mm high, ranging from small and round sporocarp-like fructifications up to plasmodiocarps of 3 mm length. Hypothallus inconspicuous, cream to straw-coloured (4B4-4B7), separate for each fructification. Peridium persistent, opening irregular, regularly sprinkled with separated, white patches of ash-grey (4B2) granular lime, these 30-50 μm in size, under the microscope translucent and colourless, with small warts and ridges to almost smooth. Capillitium a dense network of translucent, colourless threads 1-3 μm wide, bearing long and often confluent, sometimes branched nodes of granular lime, 50-100 μm, often attached to the peridium and of badhamioid habit. Spores in mass dark-brown (5F8 and darker) to black, globose, pale brown under transmitted light, ornamented with regular distributed, fine warts up to 0.3 μm in height, (10.5)-10.8-11.5-(12) μm.
With very small, distinct and never coalescing lime nodes, this taxon fits into the concept of *Physarum confertum*. However, the latter species is described as forming heaped fructifications with a peridium almost free of lime, and spores 10-14 μm in size.

Physarum decipiens M.A. Curtis (**R**, 2: loc. 38). Karatau Mountains, on bark of *Rhamnus*. All characters of our specimen are typical, with greenish-yellow plasmodiocarps during development as described by Jahn (1919) and the distinctive, rugulose surface. However, our collection differs by having curious spores (10.5)-11-12-(12.5) μm in diameter which are dark brown under transmitted light and ornamented with irregularly distributed, very conspicuous baculate spines up to 1.2 μm height, these often arranged in rows but leaving larger parts of the spore smooth.

Physarum didermoides (Pers.) Rostaf. (**R**, 1: loc. 18). Collected once from the bark of *Atraphaxis*.

Physarum notabile T. Macbr. (**A**, 82 + 2 field collections: loc. 4, 5, 7, 10, 11, 13, 14, 15, 16, 17, 18, 21, 22, 24, 28, 30, 31, 32, 33, 34, 37, 38) This species, usually regarded as rare in the Old World, was the most abundant myxomycete, inhabiting all types of substrata. Two destroyed and obviously wintered specimens were found in the field, both preserved in dense, up to 15 cm thick mats of the previous year stems of *Capparis spinosa*. Three forms, often with intermediate sporocarps in a given colony, could be recognised (Table 1). The most common form 1 fits best the description and the photograph given by Neubert et al. (1995: 283). However, spore colour is described as dark olive brown, more pronounced in Nannenga-Bremekamp (1991: 195) as very dark like in *P. didermoides*. Our form 1 differs in having pale spores like most of the *Physarum*-species, which is also the case in a specimen of Jaaps exsiccate series (No. 85). A specimen from Colorado (Larimer Co., cow dung, TRTC) determined by Sturgis is identical with form 2, whereas form 3 approaches somewhat *Physarum compressum* Alb. & Schwein. in habit.

Table 1. Morphological differentiation between forms of *Physarum notabile.*

character	form 1	form 2	form 3
sporotheca shape	globose-depressed to umbilicoid	globose	compressed to weakly reniform
diameter	0.5-0.7 mm	0.4-0.6 mm	0.2-0.3 x 0.5-0.8 mm
base	reddish (5B8-5D8)	dull grey (5D4-5B4)	reddish (5B8-5D8)
stalk	dark brown (5E8), solid	black	dirty brown (5F8) - black
lime nodes	40-80 μm, mostly separate	50-100 μm, sometimes coalescing	100 μm and more, coalescing to badhamioid
spore colour	violet brown (8C3-8E4) with a paler side, often a germination visible	dark violet brown (8E4) with a paler side	dark olive brown (5D4-5E5), no conspicuous paler area
diameter	(9.7)-10-10.8-(11.5) μm	(11)-11.6-12-(12.5) μm	(10.5)-11-11.5-(12) μm
ornamentation	warts < 0.4 μm high	spines 0.4-0.8 μm high	spines 0.8-1 μm high
habitat	litter and dung	preferentially dung	litter and dung

Protophysarum phloiogenum M. Blackw. & Alexop., 1975 (**O**, 3: loc. 16, 21, 24). This species was only found in the south-eastern loop of the journey, the true desert region. One of the Kazakh specimens is described and figured in Castillo et al. (1998).

Stemonitis virginiensis Rex (**R**, 1: loc. 38). Collected once on the bark of *Crataegus* from the Karatau Mountains. A small group of sporocarps matching the redescription of the species by Castillo et al. (1997) except for slightly larger spores (6.5-7.2 μm in diameter).

In addition, two forms of the Protosteliales and five forms of myxobacteria were common throughout the survey.

Protosteliales, sp. I (**A**, 42: loc. 4, 5, 10, 13, 14, 16, 17, 18, 21, 22, 24, 31, 32, 33, 37, 38). Very common on all kind of bark throughout the region, occurring rarely on litter.
Large colonies of gregarious, single, stalked but deciduous, globose, colourless and smooth spores (6.7-)7.2-8(-8.6) μm on slender, short stalks of one to two-fold spore diameter; very probably *Protostelium mycophaga* Olive & Stoianovitch.

Protosteliales, sp. II (**C**, 11: loc. 5, 11, 13, 24, 37, 38). As for the previous species, with a strong preference for bark.
An unidentified species with smaller colonies of scattered, single and stalked, deciduous thick-walled spores having a roughened surface, (7.8-)8.2-10.2(-10.8) μm in diameter, stalk not observed under the light microscope.

Myxobacterium div. spec. (**A**, 132: loc. 4, 5, 10, 11, 13, 14, 15, 16, 17, 18, 21, 22, 24, 25, 28, 31, 32, 33, 34, 38, 39). With 132 records, myxobacteria were exceedingly abundant on all substratum types throughout the region.

RESULTS AND DISCUSSION

The 146 moist chamber cultures yielded a total of 513 records, with 328 of these belonging to the myxomycetes. In the field, only 10 fructifications were collected, all under exceptional situations and representing only two species (*Didymium squamulosum* and *Physarum notabile*). Altogether, 27 species of myxomycetes, two members of the Protosteliales, and five forms of Myxobacteria (not differentiated) were registered. The average yield of the moist chambers was about 2.2 myxomycete species per culture. Only six of the cultures gave no results; fifteen others produced only myxobacteria.

It seems to be a common biological rule that extreme environments have impoverished floras, albeit with a few, extremely abundant species. The results of the study presented here confirm this. Compared with surveys from wooded areas (Stephenson et al. 1993, Schnittler & Novozhilov 1996), the desert investigated harbours a rather poor myxomycete flora. If only species regularly (more than two records) occurring in true desert habitats and outside the Karatau Mountains are regarded, the species list declines from 27 to 15, but these are species often found with exceedingly high frequencies (*Echinostelium colliculosum*: 43 of 81 cultures with bark; *Physarum notabile*: 82 of 146 cultures). These and other species previously regarded as rare (e.g. *Echinostelium arboreum* and *Macbrideola oblonga*) underline the distinctiveness of this desert myxomycete flora. From a number of substrata, especially bark of desert shrubs (e.g., *Atraphaxis replicata* and *Calligonum densum*), all cultures yielded myxomycetes. Under favourable weather conditions, literally each square centimetre of bark must be covered with myxomycetes.

Bark yielded most of the species, as well as most of the records, followed by litter and dung. Only two species occurred exclusively on animal droppings (*Didymium annulisporum* and *Licea* spec., both recorded only once), although dung is well known as an occasional substratum for many species (Eliasson & Lundqvist 1979). Of particular interest is the abundance of myxomycete taxa forms often regarded as ancient, such as *Echinostelium*, *Protophysarum* or the *Protosteliales* in comparison to the poor total myxomycete flora. The extremely high abundance of corticolous myxomycetes stands in contrast to the purity and scarcity of the epiphytic lichen flora (about 10 species only); 26 bark moist chambers were from taller shrubs almost free of epiphytic lichens, and 21 (81%) of these yielded myxomycetes. From the 46 moist chambers of shrubs with epiphytic lichen coverage exceeding 5%, 43 (93%) yielded myxomycetes.

What are the limiting factors for myxomycete diversity in such extreme environments? One obvious and striking factor is the very harsh climate, with only two short time windows (spring and autumn) available for myxomycete development. An indirect confirmation for this assumption is the appearance of additional species (*Perichaena depressa*, *Physarum cinereum*, *P. decipiens*, and *Stemonitis virginiensis*) in the Karatau Mountains, characterised by a more steppe-like vegetation and a slightly more humid climate. The extreme fluctuations in air humidity favour species with a short development time or those able to survive repeated desiccation during development. The rarity of decaying wood is a further limitation; dead branches remain over a long time on the shrubs, and those on the ground dry out quickly due to their small diameter. Due to the extremely cold winters, the region lacks any succulent plants, thus excluding species such as *Badhamia gracilis* (T. Macbr.) T. Macbr., known from arid regions but with a strong preference for decaying succulents (Blackwell & Gilbertson 1980, Eliasson 1991). Thin litter mats were observed only under the rare denser shrubs with well-developed foliage (e.g., *Rhamnus sintenisii*, *Ammodendron eichwaldii*) or as heaps of dead branches like in *Capparis spinosa*, thus limiting the number of litter species. A less obvious factor is the high pH of all substrata, usually ranging from 7.4-8.2. The reasons are the often salty soils as well as the actual plant substrata; especially the abundant *Chenopodiaceae* with high Na^+ and ash contents. These high pH values may be a reason for absence of most members of the Stemonitales, Liceales and Trichales except *Perichaena*. The only exception, bark of *Tamarix* (pH 4.6-7.2, n=5), harboured a different myxomycete flora (e.g., *Comatricha laxa*, *C. pulchella*, *Arcyria minuta*, and *Licea biforis*).

Table 2. Comparison of regional myxomycete floras with the results of the present survey. T - total number of species recorded, S - species shared, and CC - coefficient of community. For data sets from the boreal zone, compare Schnittler & Novozhilov (1996).

climate	T	S	CC	region and source
boreal	90	9	0.15	Russian Karelia (Schnittler & Novozhilov 1996)
boreal	125	10	0.13	boreal Finland (Härkönen 1979a, b, 1981, 1989)
boreal	101	8	0.12	boreal Sweden (Eliasson 1975, 1977, Eliasson & Lundqvist 1979, Eliasson & Strid 1976, Eliasson & Sunhede 1972, Fries 1899, 1906, 1910, 1912, Harling 1952, Santesson 1948, 1964)
temparate	106	5	0.07	(Stephenson et. al. 1993)
montane	56	-	0.00	(Stephenson et. al. 1993)
subtropical	77	7	0.13	(Stephenson et. al. 1993)
tropical	101	11	0.17	(Stephenson et. al. 1993)
tropical	94	10	0.16	Hawaii (Eliasson 1991)
medi-terranean	93	10	0.17	Israel (Ramon 1968, Binyamini 1986, 1987, 1991)
desert	39	9	0.27	Arizona (near Tucson, Chaparral and desert records only: Evenson 1961; Sonora: Blackwell & Gilbertson 1980)

Compared to surveys in temperate and tropical regions having a humid climate, the myxomycete species list obtained in the present study is short, but it comprises one of the most distinct myxomycete floras on Earth. Expressed in terms of similarity (coefficient of community, compare Stephenson et al. [1993]) the species inventory shows very low degrees of similarity (0.07-0.15) with all temperate regions and only slightly higher ones (0.13-0.17) with tropical and subtropical regions (Tab. 2). Surprisingly, the Mediterranean region also is very different (0.17 for myxomycetes from Israel). Only the flora of a hot desert (Arizona) shows a higher degree of similarity (0.27). Consequently, it can be expected that the most similar flora in the New World should occur in a winter-cold desert such as the Mojave region.

The area investigated in the present study is still too small to reveal differences in geographical distribution. Among the five main habitat types, sand dune areas showed the highest richness of species, correlating with a richer and more abundant shrub flora. Some shrubs, such as the *Calligonum* species, are limited to sand dunes. Obvious differences in the species inventory existed only for the Karatau Mountains, which have more rainfall, non-calcareous soils and with *Crataegus ambigua* the only true tree of the region. In terms of vegetation, this region can be regarded as the southernmost steppe peninsula.

At the present level of knowledge, further comparative investigations in other arid regions are necessary to explore the whole richness of desert myxomycetes and reveal their world-wide distribution patterns.

ACKNOWLEDGEMENTS

Field work of the first author was supported by a travel grant (40095/705.6.168) from the Stifterverband für die Deutsche Wissenschaft. For confirming determinations or loan of authentic or type material, we are indebted to D.W. Mitchell, G. Moreno, D. Wrigley de Basanta and Y. Yamamoto. Thanks are also due to D.W. Mitchell for revising the determination of *Comatricha laxa* and S.L. Stephenson for discussing and proof-reading the manuscript.

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MYCOTAXON

Volume LXXIV(2), pp. 287-300 April-June 2000

CONTRIBUTION OF ANDRÉ MAUBLANC TO MYCOLOGY.
I – ANNOTATED LIST OF PUBLICATIONS

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ABSTRACT: This note introduces the scientific contribution of André MAUBLANC (1880 - 1958) through a short biography and an annotated list of his writings. Over one hundred titles pertaining to the fields of phytopathology and mycology could be retreived. They focus on diseases of cultivated plants of temperate and tropical regions, on the taxonomy of their fungal agents and also on saprotrophs. Each title is provided with a concise note underlining the original approach of the research undertaken.

These publications apparently suffer from no longer being considered of interest although they deal with problems that even today have not been resolved.

KEY WORDS: fungi, phytopathology, biography, bibliography, taxonomy, crops, temperate zone, tropical regions.

INTRODUCTION

André (Pierre, Jules) MAUBLANC (1880-1958), remains the last French naturalist phytopathologist with a marked interest in fungal taxonomy. His notable achievements in both fields of research were undertaken throughout the first half of the twentieth century. Interestingly, however, his scientific contribution has never been considered on a global scale. Such concerns his numerous titles and new binomials he introduced mostly in the early decades of his career.

Maublanc graduated from the 'Paris Institut National Agronomique' at the turn of the twenty century. Soon after, he joined the recently organised 'Station

Centrale de Pathologie', which, at that time, was located a short distance from the Institute. There he was introduced to plant pathology and mycology by such eminent teachers as E. Prilleux, G. Delacroix and E. Griffon. After his engagement in the first world war, Maublanc was appointed at this Institute where he taught plant pathology and botany until his retirement in 1948. Maublanc was also involved in teaching both disciplines in two other institutes: 'Institut National d'Agronomie Coloniale' and 'Institut Technique de Pratique Agricole'. This longstanding career was, nonetheless, interrupted once by his 1912 - 1914 journey to Brazil being sent there to organize a phytopathological laboratory at the National Museum of Rio de Janeiro (Saint-Jore & Mouchacca, 1999).

Starting in 1903 and up to the first world war, Maublanc authored a large number of papers on plant diseases induced by fungi and on taxonomic mycology. These included the diagnoses of a fair number of new taxa developing on material collected in France and on specimens received at the Pathology Station either from local farmers or from overseas territories. Maublanc then also achieved the publication of two text books of plant pathology left incompleted by the death of G. Delacroix. After 1920, Maublanc pursued his investigations on microfungi inducing diseases of tropical and temperate plants and of material brought back from Brazil. But then he also developed an interest in higher fungi. This was rapidly materialized by a popular book on edible and poisonous mushrooms. The latter appeared in several editions between 1920 to 1940.

The study of basidiomycetes then became the dominant field of research pending his collaboration with the Swiss Paul Konrad. This association resulted in the preparation of the *Icones Selectae Fungorum* (1924 - 1937) and of two basic books on the systematics of higher fungi. In the same period, Maublanc issued the enlarged new version of his former popular book which was re-entitled 'Les Champignons de France'; the latter was also the subject of several new editions.

Besides his teaching commitments and research on fungi, Maublanc also accepted some side responsibilities. He was elected General Secretary of the French Mycological Society; a position he first occupied during the four years before his Brazilian trip and again for a very long period extending from 1920 to 1957. In this last year, he became President of the Society. Maublanc was also twice proposed as President of the French Society of Plant Pathology (1930 & 1939).

Maublanc's fields of interest extended beyond plant pathology and mycology. Indeed he soon became noted for his wide knowledge of other natural history disciplines such as entomology, geology, etc. This interest is behind his membership of other scientific and popular societies such as the French Entomological and Botanical Societies and the 'Société des Naturalistes Parisiens'. His implications in these domains culminated in his proposal as President of the French Entomological Society in 1942 and the French Botanical Society in 1945. In 1957, Maublanc assumed in addition the Presidency of the 'Société des Naturalistes Parisiens'.

Maublanc's notes on phytopathology on tropical and temperate plants were published mostly in journals which ceased to be published several decades ago. These publications apparently suffer from no longer being considered of interest although they deal with problems that even today have not been resolved.

The present note provides an annotated list of Maublanc's titles. The taxonomic status of names he introduced will be considered in a subsequent note.

ANNOTATED LIST OF PUBLICATIONS

ABBREVIATIONS: Journal titles were abbreviated following B-P-H/S (Botanico-Periodicum-Huntianum/Supplementum Hunt Institute for Botanical Documentation, Pittsburgh, 1991). Author's names are abbreviated following Brummit & Powell (1992).

1903

MAUBLANC A. Sur quelques espèces nouvelles de champignons inférieurs. Bull. Trimestriel Soc. Mycol. France 19 : 291-296. Provides descriptions of 18 species new to science belonging to the Ascomycotina and the deuteromycotina and the new entomopathogenic form genus *Nomuraea*.

1904

MAUBLANC A. Espèces nouvelles de champignons inférieurs. Bull. Trimestriel Soc. Mycol. France 20 : 70-74. Several new species and varieties of ascomycetes and deuteromycetes are proposed from material collected in France and Mexico.

MAUBLANC A. & LASNIER E. Sur une maladie des *Cattleya*. Bull. Trimestriel Soc. Mycol. France 20 : 167-192. Examination of infected leaves from plants of the genus *Cattleya* provided a pure strain of the causal agent; the latter proved to represent a new ascomycete, then proposed under the binomial *Physalospora cattleyae* Maubl. & Lasnier.

MAUBLANC A. Sur une maladie des olives due au *Macrophoma dalmatica* (Thüm.) Berl. & Vogl. Bull. Trimestriel Soc. Mycol. France 20 : 229-232. Features symptoms of a previously unknown olive disease with a description of the coelomycete causal agent.

MAUBLANC A. A propos du *Dasyscypha calyciformis* (Willd.). Bull. Trimestriel Soc. Mycol. France 20 : 233-235. A description of this discomycete is provided based on infected fir samples collected by G. Delacroix. Maublanc suggests the ascomycete, formerly observed on several conifers, is a saprophyte that develops at the periphery of the wounds or on the killed bark of the trees.

1905

MAUBLANC A. Travaux de la Station de Pathologie Végétale. Espèces nouvelles de champignons inférieurs. Bull. Trimestriel Soc. Mycol. France 21: 87-94. In this paper, Maublanc introduced 15 new species of ascomycetes and deuteromycetes from material collected in France and overseas.

MAUBLANC A. Travaux de la Station de Pathologie Végétale. *Trichoseptoria fructigena*, nov. sp. Bull. Trimestriel Soc. Mycol. France 21 : 95-97. The new deuteromycete *Trichoseptoria fructigena* Maubl., developing on *Pyrus malus* and *Cydonia vulgaris* in France, is introduced.

1906

MAUBLANC A. Sur quelques espèces nouvelles ou peu connues de Champignons inférieurs. Bull. Trimestriel Soc. Mycol. France 22 : 63-70. This paper considers species and varieties of ascomycetes and deuteromycetes yet unrecorded for the French, Spanish and Brazilian mycobiotas. New binomials established are: *Calospora tamaricis* and its var. *zignoelloides*, *Diplodiella tamaricis*, *Septoria azalae-indicae*, *S. phaseoli*, *Gloeosporium ricini*, *G. phaji*, *G. sobraliae*, *G. dendrobii*, *Marssonia obtusata*, *Ramularia ligustrina* and *Melanobasidium mali* gen. nov., sp. nov.

MAUBLANC A. Quelques champignons de l'est africain. Bull. Trimestriel Soc. Mycol. France 22 : 71-76. Reports on several rust and smut pathogens from plant material collected by G. Le Testu in Portuguese East Africa, now Moçambique. New binomials proposed are: *Puccinia Le Testui*, *Ravenelia Le Testui*, *Pleoravenelia deformans* and *Ustilago andropogonis-finitimi.*

1907

MAUBLANC A. Sur quelques champignons inférieurs nouveaux ou peu connus. Bull. Trimestriel Soc. Mycol. France 23 : 141-145. New taxonomic proposals are: *Physalospora populina*, *Sphaerella tabaci*, *Plowrightia agaves*, *Hysterostomella elaeicola*, *Phoma nicotianae*, *Cytosporina halimi* and *Camarosporium persicae*.

MAUBLANC A. *Ceratopycnidium*, genre nouveau de Sphéropsidées. Bull. Trimestriel Soc. Mycol. France 23 : 146-149. Introduces the new coelomycete genus *Ceratopycnidium* Maubl., type species *C. citricolum* Maubl.

MAUBLANC A. Sur une maladie des sapins produite par le *Fusicoccum abietinum*. Bull. Trimestriel Soc. Mycol. France 23 : 160-173. Reviews symptoms of the disease known as the red fir disease. In line with previous authors, Maublanc ascribes the causal agent to *Fusicoccum abietinum*, a description of which is also presented. A list of other fungi observed is also included. Some nomenclatural decisions are forwarded including two combinations: *Rhizosphaera pini* (Corda) Maubl. and *Toxosporium camptospermum* (Peck) Maubl.

PRILLEUX E. & MAUBLANC A. La maladie du sapin pectiné dans le Jura. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 145 : 699-701. Reports symptoms and origin of this fir disease. The authors advocate the establishment of a mixed vegetation of fir and beech trees up to 800 m altitude and a combination of fir-spruce at higher levels.

1908

GRIFFON E. & MAUBLANC A. Sur le blanc du chêne. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 147 : 437-439. An overview of the oak downy mildew in France.

GRIFFON E. & MAUBLANC A. Notes sur diverses maladies des branches du pommier. Bull. Soc. Nat. Hort. France, 8 p. A popular note on common twig diseases of apple trees.

1909

MAUBLANC A. Les maladies des pays chauds (1). Maladies du cacaoyer. I. La pourriture brune des cabosses. II. *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. Agric. Prat. Pays Chauds 9 (79) : 314-324. This paper is the first of a series of notes on plant diseases in tropical regions. It considers a disease of cacao trees: the brown rot disease of pods with notes on the causal agent.

MAUBLANC A. Les maladies des pays chauds (2 - suite). Maladies du cacaoyer (suite). III. Le chancre du cacaoyer. IV. Les balais de sorcière du cacaoyer. V. Pourridié des racines du cacaoyer. Agric. Prat. Pays Chauds 9 (80) : 393-407. A survey of three fungal diseases of cacao trees.

MAUBLANC A. Rapport sur la session générale organisée à Paris en octobre 1908 par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 25, pp. XV-XXXIX. Report on the annual general session of the French Mycological Society presented by the General Secretary A. Maublanc. Included is a list of mushrooms collected during the October 1908 forays made in the forests of Saint-Germain and Compiègne and in localities around Versailles.

GRIFFON E. & MAUBLANC A. Le blanc du chêne. Bull. Trimestriel Soc. Mycol. France 25 : 37-50. An overview of the oak downy mildew in France and Europe, on susceptible host plants and on the origin of the disease.

GRIFFON E. & MAUBLANC A. Sur une maladie du Cacaoyer. Bull. Trimestriel Soc. Mycol. France 25 : 51-58. Reports on a root and twig disease of cacao trees grown in Africa (Gabon) evidenced by the development of small black pustules. An isolate of the causal agent matched the description of *Botryodiplodia theobromae* Pat., a polyphagous coelomycete then found to be best accomodated in the form genus *Lasiodiplodia* Ellis & Everh.

GRIFFON E. & MAUBLANC A. Notes de mycologie et de pathologie végétale. Bull. Trimestriel Soc. Mycol. France 25 : 59-63. The first part of this contribution groups the protologues of four new taxa: *Colletotrichum ixorae*, *Dichomera carpini*, *Naemaspora jasmini* and *Chaetophoma erysiphoides.* The second concerns the diseases and pathogens of the following pathologies submitted to the plant pathology laboratory: *Gloeosporium nervisequum* (Fuckel) Sacc. on platanus, *Cercospora microsora* Sacc. on lime-tree, *Urocystis cepulae* Frost a smut of onion and leek and *Phyllosticta brassicae* (Curr.) Westend. on cauliflower.

GRIFFON E. & MAUBLANC A. Observations sur quelques maladies de la betterave. Bull. Trimestriel Soc. Mycol. France 25 : 98-107. This first contribution on sugar-beet diseases reviews problems of heart decay, leaf diseases and formation of outgrowths or roots.

GRIFFON E. & MAUBLANC A. Sur une nouvelle rouille des Orchidées des serres. Bull. Trimestriel Soc. Mycol. France 25 : 135-139. Introduces the novel rust *Hemileia oncidii* Griffon & Maubl. observed on several Brazilian Orchids grown in greenhouses around Paris. According to the authors, the disease does not markedly affect the plants. To arrest its extension, the lower leaf surface should be washed with water supplemented with 'tobacco juice and black soap'.

GRIFFON E. & MAUBLANC A. Notes de pathologie végétale (mildiou, black-rot, rouilles). Observations sur quelques maladies de la vigne. Observations sur les rouilles des plantes cultivées en 1908. Bull. Trimestriel Soc. Mycol. France 25 : 140-146. This synthetic note conveys observations made at the Paris Plant Pathology Station in the year 1908 on some diseases of vine (powdery mildew and black-rot in the centre of France) and rusts of some cultivated plants such as cereals and some nursery trees and shrubs.

GRIFFON E. & MAUBLANC A. Sur quelques champignons parasites des plantes de serres. Bull. Trimestriel Soc. Mycol. France 25 : 238-242. Descriptions of fungi pathogenic to greenhouse plants of the genera *Clusiae*, *Dracaenae* and *Codiaeum*; two fungi are new proposals: *Pestalozzia clusiae* Griffon & Maubl. and *Phyllosticta dracaenae* Griffon & Maubl.

1910

MAUBLANC A. Rapport sur la session générale et les herborisations organisées aux environs de Dijon en octobre 1909 par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 26, pp. I-XXI & XXXI. A report on the plenary October 1909 session of the French Mycological Society. Includes the list of fungi from forays made around the cities of Autun, Epinac and Semur and in the woods of Gevrey-Saulun and Beaune.

MAUBLANC A. Les maladies des pays chauds (3 - suite). Maladies du cotonnier. I. Le chancre du collet du cotonnier. Agric. Prat. Pays Chauds 10 (83) : 105-111. After reviewing the diseases of cacao trees, those of cotton bushes are debated starting with that of the collar canker.

MAUBLANC A. Les maladies des pays chauds (4 - suite). Maladies du cotonnier (suite). II. Maladies de la mosaïque et maladies analogues. III. Antrachnose du coton.

Agric. Prat. Pays Chauds 10 (84) : 214-223. More diseases of cotton bushes are discussed.

MAUBLANC A. Les maladies des pays chauds (5 - suite). IV. Maladies diverses des racines. V. Maladies diverses des tiges. VI. Maladies des feuilles. VII. Maladies des fruits. Agric. Prat. Pays Chauds 10 (85) : 295-304. Descriptive cards of several common tropical diseases of roots, twigs, leaves and fruits of important crops.

MAUBLANC A. Les maladies des pays chauds (6 - suite). Maladies de la canne à sucre. Agric. Prat. Pays Chauds 10 (90) : 232-252. Descriptive cards of common diseases of sugar cane and their causal agents.

MAUBLANC A. Les maladies des pays chauds (7 - suite). Maladies de la canne à sucre. Agric. Prat. Pays Chauds 10 (91) : 312-320. Further information on diseases of sugar cane.

MAUBLANC A. Les maladies des pays chauds (8 - suite). Agric. Prat. Pays Chauds 10 (92) : 379-400. Reviews several diseases of tropical crops.

MAUBLANC A. Les maladies des pays chauds (9 - suite). Agric. Prat. Pays Chauds 10 (93) : 502-505. More information on tropical plant diseases of economic importance.

MAUBLANC A. Notes complémentaires (maladies du caféier, du théier, du cotonnier et du cacaoyer). Agric. Prat. Pays Chauds 10 (93) : 506-512. Unreported observations by the author on pathogens of diseases of coffee, tea, cotton and cacao trees.

GRIFFON E. & MAUBLANC A. Sur une maladie des perches de chataîgnier. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 151 : 1149-1151. A description is provided of the disease of chestnut-poles in the French Limousin region. Observed symptoms are believed to match a similar disease reported few years ago from Italy by Briosi & Farneti. The latter ascribed this ink disease of chestnut-trees to the widespread *Melanconis perniciosa* commonly detected only as its anamorphic form *Coryneum*. However, the French authors favour the hypothesis that the hyphomycete isolated by the Italians would rather be a synonym of *Melanconis modomia* Tul.

GRIFFON E. & MAUBLANC A. Nouvelles recherches sur la pourriture du coeur de la betterave. Bull. Trimestriel Soc. Mycol. France 26 : 126-131. By using pure cultures, the authors proved that the disease known as heart decay of sugar-beet corresponds, in fact, to two disorders: the true heart decay induced by *Phoma tabafica* and the drying of the heart leaves due to a species of *Cladosporium*. These results were in line with the field observations and the disease hypothesis formulated earlier by Krüger in 1894.

GRIFFON E. & MAUBLANC A. Le blanc du chêne et l'*Oïdium quercinum* Thümen. Bull. Trimestriel Soc. Mycol. France 26 : 132-137. A study of the widespread oak powdery mildew disease definitely distinct from *Oïdium quercinum*. Pending the discovery of the perfect state, the new provisional name *Oïdium alphitoïdes* Griffon & Maubl. was proposed.

GRIFFON E. & MAUBLANC A. Sur des espèces de *Sphaeropsis* et de *Diplodia* parasites du Poirier et du Pommier. Bull. Trimestriel Soc. Mycol. France 26 : 307-316. Observations confirmed that apple and pear trees were susceptible to attack by taxa of the genus *Sphaeropsis* as *S. malorum* Peck and *S. pseudodiplodia* (Fuckel) Delacr. Also by the morphologically similar genus *Diplodia*. However, developing taxa of the latter genus though morphologically distinctive were not identified to the species level. These coelomycetes though commonly reported as saprophytes, may sometimes act as wound parasites capable of killing a large area of the cortex.

GRIFFON E. & MAUBLANC A. Une Chytridinée nouvelle parasite d'un gazon de Ray-grass. Bull. Trimestriel Soc. Mycol. France 26 : 317-321. Examination of lawn samples of Ray-grass from Fontainebleau developing symptoms of 'yellowing' led to the isolation of a novel Chytrid described as *Cladochytrium caespitis* Griffon & Maubl.

GRIFFON E. & MAUBLANC A. Sur une maladie des perches du Chataîgnier. Bull. Trimestriel Soc. Mycol. France 26 : 371-381. A synthetic report on the Chestnut pole disease widespread in France, Italy and Portugal. The causal agent of the developing elongated spots is *Melanconis modomia* Tul. with the conidial state renamed *Coryneum modonium* (Tul.) Griffon & Maubl.

1911

GRIFFON E. & MAUBLANC A. Notes de pathologie végétale. I. Une maladie des feuilles de la rose de Noël. II. Une maladie de l'aubergine. III. Maladies des céréales (rouilles, piétin, noirs). IV. Maladies du cœur de la betterave. V. Maladies à sclérotes. VI. Maladies de la pomme de terre et de la tomate en 1910. VII. Le mildiou de la vigne en 1910. VIII. Le blanc de chêne en 1910. IX. Blanc de groseillier. X. Maladie verruqueuse de la pomme de terre. Bull. Trimestriel Soc. Mycol. France 27 : 47-67. Descriptions of fungi parasitising plants of economic importance in the domain of agricultural, horticultural and forestry. For some of the agents, an evaluation of losses is undertaken. Relevant measures of controls are also debated.

GRIFFON E. & MAUBLANC A. Deux moisissures thermophiles. Bull. Trimestriel Soc. Mycol. France 27 : 68-74. Protologues of two thermophilic hyphomycetes: *Penicillium dupontii* Griffon & Maubl. and *Sepedonium lanuginosum* (Miehe) Griffon & Maubl.

GRIFFON E. & MAUBLANC A. Notes de pathologie végétale et animale. I. Sur le *Plasmodiophora brassicae*. II. Sur un cas de décurtation des jeunes rameaux d'Epicéa. III. Sur une maladie des olives dans les Alpes-Maritimes. IV. Champignons nouveaux parasites des poires. V. Sur une maladie des poissons causés par une Saprolégniée. Bull. Trimestriel Soc. Mycol. France 27 : 469-475. Five particular pathologies are reviewed including a disease of young twigs of spruce trees, an olive disorder due to *Gloeosporium olivarum* Ver. d'Alm. in the region of the Alpes-Maritimes and finally a fish disease induced by one of the Saprolegniales. The chapter on pear diseases contains Latin descriptions of the new genus *Lasiostroma* and of *Phoma umbilicaris* (see also next paper).

GRIFFON E. & MAUBLANC A. Contribution à l'étude des maladies des pommes et des poires. Ann. Inst. Natl. Agron., Paris, 2ème série, t. 10, pp. 69-106. Conveys original information and drawings of several parasitic diseases of apples and peaches. The study was carried out at the plant pathology station and followed by a prospective research to define climatic and cultural conditions favouring each disease and to select appropriate field measures to limit losses. The new decay fungal agent of peaches *Lasiostroma pirorum* Maubl. gen. nov., sp. nov., is described in addition to *Phoma umbilicaris* (see also previous paper).

MAUBLANC A. Rapport sur la session générale organisée en septembre et octobre 1910 aux environs de Grenoble et d'Annecy par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 27, pp. I-XXX. This report comprises the list of fungi collected in the forays organised in the neighbourhood of Grenoble and Annecy during September and October 1910 by the French Mycological Society.

1912

GRIFFON E. & MAUBLANC A. Les *Microsphaera* des Chênes. I. Les *Microsphaera* américains des Chênes. II. Les *Microsphaera* européens des Chênes. Bull. Trimestriel Soc. Mycol. France 28 : 88-104. An overview of *Microsphaera* species on American and European oaks. The authors concluded that the *Microsphaera* responsible for the oak downy mildew is distinct from American species and from those reported earlier in Europe. The new taxon of unknown origin but most probably of recent introduction into Europe is proposed with the following binomial: *Microsphaera alphitoïdes* Griffon & Maubl.

MAUBLANC A. Rapport sur la session générale organisée en octobre 1911 aux environs de Paris par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 28, pp. I-XVI. List of mushrooms collected in the forests of Villers-Cotterêts, Saint Germain and Fontainebleau, situated around Paris, during the October 1911 forays organised by the French Mycological Society.

MAUBLANC A. Maladies du vanillier. Antrachnose du vanillier (*Calospora vanillae* Massee). Maladies des taches brunes des tiges (*Nectria vanillae* Zimm.). Agric. Prat. Pays Chauds 12 (108): 177-188. Diseaes of vanilla plants. Two diseases are reviewed.

MAUBLANC A. Maladies du vanillier (suite). Anthracnose du vanillier, suite (*Calospora vanillae* Massee). Maladies diverses du vanillier. Agric. Prat. Pays Chauds 12 (109) : 277-287. Further notes on diseases of vanilla plants.

1913

MAUBLANC A. Edouard Griffon (1869-1912). Bull. Trimestriel Soc. Mycol. France 29 : 197-205. A comprehensive obituary of the French phytopathologist.

GRIFFON E. & MAUBLANC A. Sur quelques champignons parasites des plantes tropicales. I. Une maladie de l'*Hevea brasiliensis*. II. Une maladie du Karité (*Butryospermum parkii*). Bull. Trimestriel Soc. Mycol. France 29 : 244-250. This note reports on the isolation of *Dothidiella ulei* Henn. from leaves of *Hevea brasiliensis* collected close to Balem (Para) at the mouth of the Amazon river. Two other pathogens of 'karité' plants grown in Africa (Haut Sénégal and Niger) are proposed as new taxa: *Fusicladium butyrospermi* Griffon & Maubl. and *Pestalozzia heterospora* Griffon & Maubl.

MAUBLANC A. Sur une maladie des feuilles du papayer (*Carica papaya*). Bull. Trimestriel Soc. Mycol. France 29 : 353-358. Note on a leaf disease. The morphology and taxonomy of the causal agent are discussed. To accomodate the fungus, the new genus *Asperisporium* is established with *A. caricae* (Speg.) Maubl. as type species. Three other taxa will also be transferred to *Asperisporium* Maubl.

MAUBLANC A. Rapport sur les maladies observées au Laboratoire de Phytopathologie du Musée National de Rio de Janeiro. Bulletin mensuel des renseignements agricoles et des maladies des plantes 4 (6) : 1-6. A report on most common pathogens of Brazilian crops and specifically of those grown in the southern states between Rio de Janeiro and Rio Grande; this area was the only part of the country for which the Laboratory of Phytopathololgy had collected substantial data. Crops investigated were the following: coffee, sugar cane, tobacco, corn, maté, rice, cotton, vine, wheat, fruit trees and some vegetable and ornamental plants.

MAUBLANC A. Bericht über die in dem phytopathologieschen Laboratorium des National-Museums in Rio de Janeiro beobachteten Pflanzenkrankheiten. Internationale Agrartechnische Rundschau 4 (1-2 : januar-februar 1913) : 717-720. A German version of the previous report on plant diseases observed at the Phytopathology Laboratory of the National Museum of Rio de Janeiro.

MAUBLANC A. & RANGEL E. Le *Stilbum flavidum* Cooke parasite du caféier et sa place dans la classification. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 157 : 858-860. A study of the polyphagous *Stilbum flavidum* was undertaken by incubating coffee leaves in humid chambers. The fungus proved to be the abortive sterile state of the new Basidiomycete *Omphalia flavida* Maubl. & Rangel.

1914

MAUBLANC A. & RANGEL E. Le *Stilbum flavidum* Cooke, forme avortée de l'*Omphalia flavida* n. sp. Bull. Trimestriel Soc. Mycol. France 30 : 41-47. Protologue of *Omphalia flavida* Maubl. & Rangel with details about conditions required for the development of its carpophores.

MAUBLANC A. L'*Ustulina pyrenocrata* Theissen, type du genre nouveau *Theissenia*. Bull. Trimestriel Soc. Mycol. France 30 : 48-53. From the cortex of a tree having the common name 'Minjoleiro' in the São Paulo area, Maublanc isolated a fungus matching the description of *Ustulina pyrenocrata* Theiss. A more elaborate study concluded the latter should be considered as the type species of the new genus *Theissenia* Maubl.

MAUBLANC A. Les genres *Drepanoconis* Schr. et Henn. et *Clinoconidium* Pat. : leur structure et leur place dans la classification Bull. Trimestriel Soc. Mycol. France 30 : 441-449. During his Brazilian stay, Maublanc was able to study both genera on undetermined plants of the family *Lauraceae*. He concluded that the genera *Clinoconidium*, *Drepanoconis* and *Coniodyctium* are distinguishable by conidial morphology and septation but interrelate by their structure and habit of life. These entities could thus be placed but provisionally in the Melanconiaceae.

1915

MAUBLANC A. & RANGEL E. Alguns fungos do Brasil, novos ou mal conhecidos. Bol. Agric. (São Paulo) 16 : 310-328. Provides a list of Basidiomycetes, Pyrenomycetes, Sphaeropsidales, Melanconiales and Hyphomycetes less common or yet unknown from Brazil. Establishment of new genera including *Chaetolentomita* Maubl.

MAUBLANC A. & RANGEL E. Über neue und wenig bekannte Pilze Brasiliens. Internationale Agrartechnische Rundschau 6 (7 : juli 1915) : 1210-1211. A list of 42 taxa belonging to the Ascomycotina and the deuteromycotina less common or yet unreported from Brazil. A condensed review of the previous note.

1920

MAUBLANC A. Contribution à l'étude de la flore mycologique brésilienne. Bull. Trimestriel Soc. Mycol. France 36 : 33-43. Reports the descriptions of several Brazilian fungi based on specimens collected by Maublanc. Proposal of some new taxa including the new ascomycetous genus *Uropolystigma* Maubl.

MAUBLANC A. & NAVEL H.C. Sur une maladie du palmier à huile (*Elaeis guineensis* Jacq.) aux îles San-Thomé et de Principe produite par un champignon (*Ganoderma applanatum* Pers.). Agron. Colon. 30 (mai-juin 1920) : 187-191. Describes symptoms of a new disease of oil palm trees. The authors insist on the need for a follow up of the plantations to assess the evolution of the disease which may prove to be highly destructive. They suggested to adapt local cultural methods and the application of simple prophylactic measures such as burning the attacked trees, wound disinfection with a ferric sulfate solution followed by application of tar, sealing of cavities with a solid material such as cement in order to increase trunk solidity and delay its rupture.

1922

MAUBLANC A. La pourriture brune du Cacaoyer. Agron. Colon., N.S., xi, 54, pp. 177-184. A survey of the history, distribution and symptoms of the brown decay disease of cacao trees. After providing a protologue for the novel causal agent

Phytophthora faberi Maubl., the author reviews the parameters of disease development and control measures.

1923

MAUBLANC A. Rapport sur la session générale organisée en octobre 1922, aux environs de Lyon par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 39, pp. IX-XXVIII. Report on the annual session of the French Mycological Society held in October 1922 with the list of taxa collected during the forays organised around the cities of Tarare, Saint Nonnet-le- Froid, Vienne and Charbonnières.

MAUBLANC A. La mosaïque de la canne à sucre. Agron. Colon., N.S., viii, 61, pp. 1-7. Reviews the history, distribution and losses due to the sugar cane mosaic. The causal agent could not be identified due to the absence in the diseased tissues of fungal or bacterial structures which could explain the symptoms. Based on published information, Maublanc favours the hypothesis of an infectious disease induced by a virus transmitted by greenflies. He then debates about the resistance and the varietal susceptibility to the disease.

1924

MAUBLANC A. Les maladies de l'Arachide. I. Maladie des tâches brunes des feuilles. II. Rouille de l'Arachide. III. Pourridié de l'Arachide. IV. Maladies à sclérotes de l'Arachide. V. Pourriture bactérienne de l'Arachide. VI. Maladies diverses ou peu connues. Agron. Colon., N.S., x, 73, pp. 1-12. A popular note on peanut disorders intended for farmers. Diseases covered are: brown leaf spots (*Cercospora personata* Ellis), rust (*Uredo arachidis* Lagerh.), rots (*Rhizoctonia*), sclerotial diseases (*Sclerotium rolfsii* Sacc.), bacterial decay (*Bacillus solanacearum* E. Smith) and other diseases of less known pathologies (mosaic, etc.). Information on prophylactic and chemical control measures are also provided.

MAUBLANC A. Compte rendu de la session générale tenue à Paris en octobre 1924 par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 40, pp. XLI-LIII. Report on the annual general meeting of the French Mycological Society with a list of mushrooms collected while foraying in the forests of Fontainebleau, Marly, Carnelle and Compiègne.

1925

MAUBLANC A. Conseils pour l'étude sur place des maladies cryptogamiques aux colonies et pour l'envoi d'échantillons d'étude. Agron. Colon., N.S., xiii, 92, pp. 57-64. This note is in relation with the author's side activities at the 'Institut National d'Agronomie Coloniale'. It conveys indications to be followed for correct handling and conditioning of infected material for examination by the phytopathology laboratory. Maublanc also stresses the type of information to be collected regarding disease evolution with a review of control measures to be applied locally.

MAUBLANC A. La maladie des tâches brunes de l'arachide en Afrique occidentale. Agron. Colon., N.S., xiii, 92, pp. 126-127. An overview of the report prepared by Mr Claveau, then Head of the Department of Agriculture, Forestry and Breeding of Sénégal and Mauritania. This document conveys data on the extension and losses induced by *Cercospora personata* Ellis, causal agent of brown leaf spot of peanuts in West Africa.

MAUBLANC A. Rapport sur la session générale tenue du 11 au 18 octobre 1925 à Bellême (Orne). Bull. Trimestriel Soc. Mycol. France, t. 42, pp. XXVI-XXXIX. Report on forays made in Saint Bomer and the forest of Bellême.

1928

MAUBLANC A. Rapport sur la session générale organisée en octobre 1927 aux environs de Paris, par la Société Mycologique de France. Bull. Trimestriel Soc. Mycol. France, t. 44, pp. IX-XXII. Collecting data from the October forays in Rambouillet and Armainvilliers.

MAUBLANC A. Observations sur quelques champignons du Brésil. I. Sur un parasite des feuilles de *Mikania*. Arch. Bot. (Paris). 2 (Bull. mens. No. 7) : 121-129. The debated pathogen is *Maireella bertioides* (Sacc. & Berl.) Maubl.

MAUBLANC A. & BARAT H. Une maladie nouvelle de la vanille. Agron. Colon., N.S., xvii, 123, pp. 77-82. Discuss symptoms of a new disease of vanilla plants developing at La Réunion island with the causal agent being a *Phytophthora*. Details of cultural and prophylactic control measures are forwarded.

1930

MAUBLANC A. & MALENCON G. Recherches sur le *Battarraea guicciardiana* Ces. Bull. Trimestriel Soc. Mycol. France 46 : 43-73. Data on the anatomy, distribution and phylogeny of the fungus are provided. It is distinguished from the closely related *Battarraea phalloïdes* by characteristics of the veil, habitat and geographic distribution.

MAUBLANC A. & MALENCON G. Sur la nature et l'organisation de la gleba du *Battarraea guicciardiana* Ces. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 190 : 510-512. A more elaborate description of this *Battarraea* species is provided.

1934

MAUBLANC A. & ROGER L. Une nouvelle rouille du caféier au Cameroun. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 198 : 1069-1070. Reports on a new disease of coffee trees in Cameroon induced by a rust.

MAUBLANC A. & ROGER L. Une nouvelle rouille du caféier au Cameroun : *Hemileia coffeicola*. Bull. Trimestriel Soc. Mycol. France 50 : 193-202. Description of a new rust species from infected coffee trees in Cameroon.

MAUBLANC A. & ROGER L. La phthiriose du caféier. Compt. Rend. Hebd. Séances Acad. Sci., Paris, 198 : 391-392. Considers symptoms and possible causes of this disease of coffee trees.

1935

MAUBLANC A. & ROGER L. La Phthiriose du caféier au Cameroun. Rev. Bot. Appl. Agric. Trop. 161 : 25-32. A study of the conidial state of *Polyporus coffeae* Wakef., infecting roots of African coffee trees. The authors note its similarity with *Bornetina corium* L.Mangin & Viala, agent of the vine phthiriose. On the basis of this assumption, the former conidial state is then considered to belong to this form genus and the disease named phthiriose of coffee trees. However, both conidial states are not considered as representing the same species.

MAUBLANC A. Rapport sur la session générale de la Société Mycologique de France tenue à Paris en octobre 1934. Bull. Trimestriel Soc. Mycol. France, t. 51, pp. III-XX. Details about forays undertaken in the forests of Villers-Cotterêts and Sénart and around the city of Beauvais.

1936

MAUBLANC A. Rapport sur la session générale de la Société Mycologique de France tenue à Barcelone du 19 au 27 octobre 1935. Bull. Trimestriel Soc. Mycol. France, t. 52 , pp. XVII-XXXII. Includes a list of mushrooms collected while foraying at the villages of Salut and Monserrat and the massif of Montseny.

1937

MAUBLANC A. Rapport sur la session générale de la Société Mycologique de France tenue à Aix-les-Bains du 20 au 27 septembre 1936. Bull. Trimestriel Soc. Mycol. France, t. 53, pp. XVII-XXVIII. List of mushrooms collected during the forays organised in the forests of Corsuet, Bouvillard and Sapenay and during the excursions at la Chartreuse de Saint Hugon and Mont Revard.

MAUBLANC A. Contribution à la connaissance de la flore mycologique du littoral atlantique. Rev. Pathol. Vég. Entomol. Agric. 24: 121-132. A list of interesting parasitic fungi belonging to the orders Peronosporales, Ustilaginales and Uredinales. Localities investigated were in the regions of Loire inférieure (Pornic and Croisic), Charente inférieure (Mechers and Oleron Island) and in Vendée (Island of Yeu).

MAUBLANC A. & VIENNOT-BOURGIN G. Tavelures des arbres fruitiers. Journées de la lutte chimique contre les ennemis des cultures, vol. 38, No. 4 bis, octobre 1937, 5 p. A popular document on the biology of agents inducing apple and peachs discolorations. A description of the apple blotch disease caused by *Gloeodes pomigera*, a relatively inocuous disease which, however, depresses the value of infected fruits; also provides a description of the *Diplodia* on apples. Notes on appropriate control measures.

1938

MAUBLANC A. & ROGER L. Sur deux espèces du genre *Cookeina* en Afrique. Bull. Trimestriel Soc. Mycol. France 54 : 111-114. A morphological study of *Cookeina sulcipes* (Berk.) Kuntze and *C. tricholoma* Mont. *Geopyxis striatospora* Maubl. & Roger is regarded as a synonym of the former.

MAUBLANC A. & Ed. d'ASTIS. *Tricholoma abbatum* (Quélet). Bull. Trimestriel Soc. Mycol. France 54 : 67-68. *Tricholoma abbatis* revisited. Twelve specimens were found in a mixed wood of pine and green-oaks growing on a calcareous soil at an altitude of 600 m on the north side of Mont Caume.

1939

MAUBLANC A. Rapport sur la session générale de la Société Mycologique de France tenue à Paris du 9 au 20 octobre 1937. Bull. Trimestriel Soc. Mycol. France, t. 55, pp. XIX-XXXII. Report on and list of mushrooms collected during forays in the forests of Orry-La-Ville, Villers-Cotterêts, Compiègne and Fontainebleau.

1944

MAUBLANC A. Les études mycologiques dans la région parisienne. Congrès naturaliste, Paris 1944, Commémoration du Quarantenaire des Naturalistes Parisiens, pp. 52-54. A review on the history of mycological forays in the Isle de France region presented at the meeting held to commemorate fourteen years of the 'Association des Naturalistes Parisiens'.

MAUBLANC A. Contribution à l'étude de la flore cryptogamique de la région parisienne. Congrès naturaliste, Paris 1944, Commémoration du Quarantenaire des Naturalistes Parisiens, pp. 130-132. A list of interesting taxa collected in the zone extending up to 100 km around Paris and in the regions of Normandy and Loiret. These parasites of higher plants belong to the orders Peronosporales, Ustilaginales and Uredinales.

1951

MAUBLANC A. Paul Konrad (1877-1948). Bull. Trimestriel Soc. Mycol. France 67 : 329-335. Obituary.

1953

MAUBLANC A. A propos de quelques champignons printaniers. Bulletin des Naturalistes Parisiens, N.S., 8 : 3-6. A popular note on interesting finds of spring mushrooms made by the author.

BOOKS AUTHORED BY MAUBLANC

1909 - DELACROIX G. & MAUBLANC A. Maladies des plantes cultivées. II. Maladies parasitaires. Encyclopédie Agricole, J.B. Baillère (Ed.), Paris, 452 p., 83 pl. A comprehensive treatise on parasitic diseases of cultivated plants.

1911 - DELACROIX G. & MAUBLANC A. Maladies des plantes cultivées dans les pays chauds. Augustin Challamel (Ed.), Paris, 595 p., 70 pl. A well known general treatise of plant pathology of tropical plants.

1926 - Maladies des plantes cultivées. II. Maladies parasitaires. 2ème édition. Encyclopédie Agricole, J.B. Baillère (Ed.), Paris, 456 p., 89 pl. A revised edition of this textbook of plant pathology.

1921 - Les champignons comestibles et vénéneux. Paul Lechevallier (Ed.), Paris, 212 p., 140 figs., 96 pl. A popular treatise of edible and poisonous mushrooms. This book will be a piece of art for several decades.

1926 - Les champignons comestibles et vénéneux. 2ème édition.Tome 1. Paul Lechevallier (Ed.), Paris, 240 p., 96 pl. As the first edition proved to be very popular, Maublanc prepared an enlarged second edition that appeared in two volumes.

1928 - Les champignons comestibles et vénéneux. 2ème édition. Tome 2. Paul Lechevallier (Ed.), Paris, 240 p. The second part of the enlarged version of this popular book for mushroom collectors. The title of this book will undergo slight changes in subsequent editions.

1946 - Les champignons de France. 3ème édition, Paul Lechevalier (Ed.), Paris, cclxxvii, 2 vols., + 283 p., 240 pl. (224 col.), 57 figs. These two small volumes were aimed at being something more than merely popular books.

1952 - Les champignons de France. 4ème èdition, Paul Lechevalier (Ed.), Paris. Vols. I & II : 112 p. + 278 p. A renewed edition of this popular and highly praised book for mushroom hunters.

1959 - MAUBLANC A. & VIENNOT-BOURGIN G. Champignons de France. 5ème édition. Paul Lechevallier (Ed.), Paris., vol. I: i-iv + 305 p., portrait, 59 figs.; vol. II: Atlas, 283 p., 224 pl. (221 col.). The first volume comprises the following six chapters: introduction to fungi; classification of fungi; classification of Basidiomycetes; the Homobasidiomycetes; the Ascomycetes and finally edible and poisonous fungi.

1971 - Les champignons comestibles et vénéneux. 6ème èdition, Paul Lechevallier (Ed.), Paris. Additions to the previous editions: plates of *Cortinarius orellanus* and *Lepiota brunneo-incarnata* by G. Viennot-Bourgin. Vols. I & II : 308 p. + 285 pl.

1974 - Les champignons comestibles et vénéneux. 6ème édition, 2ème impression, Paul Lechevallier (Ed.), Paris. Vols. I & II: 308 p. + 285 pl.

1995 - Champignons comestibles et vénéneux. 7ème èdition, Paul Lechevallier (Ed.), Paris, 527 p., 230 col. pl. The latest edition of this popular book for mushroom collectors first written by A. Maublanc in 1921 was completely revised by J. PERREAU.

1924-1937 - KONRAD P. & MAUBLANC A. *Icones selectae fungorum*. Paul Lechevallier (Ed.), Paris, 6 vols. A total of 500 annotated plates and one volume with descriptions: vol. 6, 559 p. The well known *Icones selectae fungorum* were published serially in six volumes over a period of thirteen years:
Vol. 1 (1924-1930): plate Nos. 1 - 100; Vol. 2 (1930-1932): plate Nos. 101 - 199;
Vol. 3 (1932-1933): plate Nos. 200 - 299; Vol. 4 (1933-1934): plate Nos. 300 - 399;
Vol. 5 (1934-1935): plate Nos. 400 - 500; Vol. 6 (1935-1937): relevant text.

(1948) 1949 - KONRAD P. & MAUBLANC A. Les Agaricales. Classification, révision des espèces, iconographie, comestabilité. Agaricaceae. Encyclopédie Mycologique 14. Paul Lechevalier (Ed.), Paris, 469 p., 1 pl. A major taxonomic book on this large group of Basidiomycetes.

1952 - KONRAD P. & MAUBLANC A. Les Agaricales. Tome II. Russulacées, Hygrophoracées, Gomphidiacées, Paxillacées, Bolétacées. Encyclopédie Mycologique 20. Paul Lechevalier (Ed.), Paris, 220 p. The second part of a major taxonomic book on this large group of Basidiomycetes.

ACKNOWLEDGEMENTS

In tracing copies of hardly available literature the authors are much indebted to Drs. U. Braun, D. Minter and A.J.L. Phillips (Universidade do Minho) and Manuela Da Silva (Brazil). Dr. A.J.L. Phillips also seriously attempted to upgrade the English level of the text and has kindly accepted to act together with Dr. H. van der Aa as a presubmission reviewer for Mycotaxon.

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MYCOTAXON

Volume LXXIV(2), pp. 301-330 April-June 2000

CONTRIBUTION OF ANDRÉ MAUBLANC TO MYCOLOGY. II – TAXONOMIC STATUS OF INTRODUCED TAXA

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ABSTRACT: This second contribution on A. Maublanc focuses on the status of the binomials he introduced. For each binomial, basic bibliographic information with characteristics of type material are given. An extensive search was undertaken to find authentic material in the few collections comprising specimens he examined. These collections, formerly dispersed in separate institutions, are now maintained together in the Paris Museum. Whenever possible individual positions were updated and studies were initiated to resolve a few cases.

More than one hundred new species were described by Maublanc from material originating from France, South America (mostly Brazil) and Africa. Taxonomic decisions were, however, commonly established on a plant-host basis. Over half the proposals represent deuteromycetes collected in France. The remaining comprise Ascomycetes and Basidiomycetes (11 species) on a 3:1 ratio. New Ascomycetes were generally based on the Brazilian specimens collected by Maublanc. Established Basidiomycetes are rusts and smuts with most being from Africa.

The following genera were established by Maublanc: *Asperisporium, Ceratopycnidium, Chaetolentomita, Lasiostroma, Melanobasidium, Nomuraea, Theissenia* and *Uropolystigma.* Some remain unispecific and unreported since their proposal.

The following new combinations are proposed by the present authors: *Marssonina obtusata* and *Stagonospora agaves.*

KEY-WORDS: Maublanc, fungi, biodiversity, taxonomy, phytopathogens, deuteromycetes, Ascomycetes, Basidiomycetes, new taxa, France, Brazil, Africa, documentation.

INTRODUCTION

The first part of this contribution on André Maublanc considered the scientific publications and writings by this eminent phytopathologist (Mouchacca & Saint-Jore, 2000). The present note focus on the taxonomic status of the names he introduced. Titles authored by him singly or with French and Brazilian colleagues were scanned for taxonomic decisions proposed therein. Similar decisions reported in the two text books on Basidiomycete systematics prepared with the Swiss mycologist P. Konrad, are not taken into account here.

For each taxon, basic bibliographic information with characteristics of type material are given. All efforts were undertaken to update individual taxonomic positions when changes were expected to occur in the light of present-day knowledge. For names not reassessed since they were proposed, information on the respective genera is provided instead. In a few cases, a collaborative taxonomic investigation was initiated to solve pending ones (Braun & Mouchacca, in press; Vanky & Mouchacca, in press).

An extensive search was undertaken to locate original specimens of taxa described by Maublanc. Indeed, the search was started several years ago. It rapidly confirmed that material studied by him has long suffered from being scattered in separate collections commonly inaccessible to the mycological community. Thus Maublanc's prime specimens of the Paris Pathology Station were moved, in the 1920's, to the new Versailles Centre; the long forgotten herbarium of the latter was recently transferred to the Paris Museum. A similar decision was taken a few years ago about the mycological collections of the Paris Institut National Agronomique. Authentic material of Maublanc was also filed in the general herbarium of the Paris Cryptogamic Museum (PC) pending his constant visits to consult specimens maintained there.

This dispersion of his authentic material accounts for the lack of modern taxonomic studies on the taxa he introduced. These taxa relate to fungi developing on plant material collected at the beginning of the twentieth century in Europe (mostly in France), Africa and South America; for the latter two continents, the available specimens are the only ones in existence.

Several authentic specimens could not, however, be located. Nonetheless, cases of failure should not altogether be considered definitive since the content of a small collection of Maublanc at PC awaits to be indexed. Also, a few Brazilian specimens unavailable in present collections at PC, are suspected to be located in the National Museum of Rio de Janeiro where Maublanc spent two years prior to the first world war. There he started, with E. Rangel, his series of exsiccata entitled 'Fungi Brasiliensis'. A complete set is expected to be housed in that institution. A similar set does not figure in PC since Maublanc distributed his South American specimens among material he collected elsewhere.

This note aims to stimulate interest in the names coined in the early decades of the twentieth century by Maublanc for a certain number of fungi. These binomials proved to be unreported since their introduction.

STATUS OF INTRODUCED TAXA

For names published before 1920, the volume (s) of Saccardo's *Sylloge Fungorum* are added under the heading literature. These are cited whenever the corresponding binomial could be traced following the relevant general index authored by Reed & Farr (1993). References are abbreviated according to B-P-H/S (Botanico-Periodicum-Huntianum/Supplementum Hunt Institute for Botanical Documentation, Pittsburgh, 1991). Author's names are abbreviated following Brummit & Powell (1992).

The following abbreviations were also introduced in the text:
Fungi Brasiliensis: FB; Herbier de l'Institut National Agronomique, Paris: Herb. INA; Herbier de la Station Centrale de Pathologie Végétale, Versailles (S.-&-O.), France (now Centre INRA Versailles): Herb. SCPV, and Paris Cryptogamie: PC.

Two genera were dedicated to Maublanc: *Maublancia* and *Maublancomyces*. *Maublancia myrtacearum* G.Arnaud, type species of *Maublancia* G.Arnaud (Arnaud, 1918) was established for a Brazilian ascomycete developing on living leaves of a plant family *Myrtaceae*. *Maublancomyces* was based by Herter (1950) on *Helvella gigas* Krombh. and described without knowledge of the earlier name *Neogyromitra* Imai. Eckblad (1968) provided evidence that *Maublancomyces* should be considered as a synonym of *Neogyromitra* which should in turn be regarded as congeneric with *Discina* (Fr.) Fr.

Individual entries are marked by arrows. Binomials introduced by Maublanc are printed in bold characters.

CHYTRIDIOMYCETES

⇒ **Cladochytrium (Physoderma) caespitis** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 26: 320. 1910; XXI: 847. Holotype: ? On roots of *Lolium perenne*, Fontainebleau, France (date & leg. not specified).

This species was overlooked by Sparrow (1960) in his generic treatment of *Cladochytrium* Nowak.

OOMYCETES

⇒ *Phytophthora palmivora* (E.J.Butler) E.J.Butler - Scient. Rep. Agric. Res. Inst. Pusa 1918-19: 82. 1919.
Basionym: *Pythium palmivorum* E.J.Butler - Mem. Dept. Agric. India, bot. ser., 1 (5): 82. 1907.
= **Phytophtora faberi** Maubl. - Agric. Prat. Pays Chauds 9 (79): 315. 1909; XXI: 860; XXIV: 35. Holotype: ? Parasitic on fruits of cacao trees in hot regions. Synonymy *fide* Waterhouse (1970).

The protologue provided by Maublanc was based on a full description of the black pod disease in the Cameroons given by von Faber in 'Die Krankheiten und Parasiten des Kakaobaumes [Arb. K. Biol. Anst. Land. Forst. 7 (2): 197. 1909]. Von Faber, however, did not name the fungus; the latter was then dedicated to him.

Following Waterhouse (1970) 'it is usually accepted that the fungus is the same as *Phytophthora palmivora*'.

ASCOMYCETES

⇒ **Anthostomella distachya** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 87. 1905; XIX: 77; XXII: 98. Holotype: PC ex Herb. INA, same material as for

Leptosphaeria ephedra Maubl. On dry branches of *Ephedra distachya*, in the dunes close to the river mouth, Le Cormeu (Loire-inférieure), France, IV 1904, leg. A. Maublanc.

This species has been overlooked in recent relevant partial revisions of the genus (Dulymamode *et al.*, 1998).

⇒ **Asterina maublancii** (G.Arnaud) Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 38. 1920; XXIV: 460.
Basionym: *Asterina melastomatis* Lév. var. *maublancii* G.Arnaud - Ann. Ecole Natl. Agric. Montpellier, N.S., 16: 169. 1918; XXIV: 460; *nom. ill.*, Art. 34.1b. Holotype: ? On living leaves of a plant family *Melastomataceae*, close to Boe Vista, Rio de Janeiro, Brazil (date ?), leg. A. Maublanc (FB No. 370).

The original specimen was tentatively identified as *Lembosia melastomatum* Mont. by Maublanc before its redisposition by G. Arnaud.

⇒ **Botryosphaeria abietina** (Prill. & Delacr.) Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 169. 1907; the synonymy is not mentioned in Reed & Farr (1993).
Basionym: *Physalospora abietina* Prill. & Delacr. - Bull. Trimestriel Soc. Mycol. France 6: 114. 1890; IX: 594; XII: 565; XX: 391. Holotype: ?

The fungus was encountered in the course of a study of a fir tree disease in the Jura mountains, France. It has also been observed in North America (Farr *et al.*, 1989).

⇒ **Calospora tamaricis** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 63. 1906; XXII: 395. Holotype: PC ex Herb. SCPV No. 1822 a; isotype PC ex Herb. INA. On dead branches of *Tamarix* sp., Pornic (Loire-Inférieure), France, IV 1905, leg. A. Maublanc. The original material was divided into two parts now maintained in separate collections.

A second collection is also available: Herb. SCPV No. 1822 C, collected at La Briochère close to Pornic, IV 1910, leg. A. Maublanc.

⇒ **Calospora tamaricis** var. **zignoelloides** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 63. 1906. Holotype: PC ex Herb. SCPV No. 1822 b; isotype PC ex Herb. INA, same material as *Diplodiella tamaricis* Maubl. [now *Microdiplodia depazeoides* (Durieu & Mont.) Zambett.]. On dead branches of *Tamarix* sp., Pornic (Loire-Inférieure), France, IV 1905, leg. A. Maublanc.

The original material was divided into two parts now maintained in separate collections.

⇒ *Chaetosphaeria brasiliensis* (Höhn.) E.Müller, in Müller & von Arx - Die Gattungen der didymosporen Pyrenomyceten. Beitr. Kryptogamenflora Schweiz 11 (2): 588. 1962.
Basionym: *Lentomita brasiliensis* Höhn. - Denkschr. K. Ak. Wiss. Wien, math.-nat. Kl. 83: 24. 1907.
= **Chaetolentomita lignorum** Maubl., in Maubl. & Rangel - Bol. Agric. (São Paulo) 16: 313. 1915; XXIV: 1072. Holotype: Herb. Museo Rio de Janeiro No. 1009. On decaying wood, Rio de Janeiro, Brazil, 22 XII 1912, leg. Maublanc & Rangel (Exsiccata Herb. Museo Rio de Janeiro No. 1009). Synonymy *fide* Müller & von Arx (1962).

The still unispecific genus *Chaetolentomita* Maubl., type species *C. lignorum* Maubl., was regarded as a synonym of *Chaetosphaeria* Tul. by Müller & von Arx (1962).

⇒ *Cookeina sulcipes* (Berk.) Kuntze - Rév. Gen. Pl. 2: 849. 1891; Denison - Mycologia 59: 312. 1967.
Basionym: *Peziza sulcipes* Berk. - London Jour. Bot. 1: 141. 1842.
= *Trichoscypha sulcipes* (Berk.) Sacc.- *Syll. Fung.* 8: 161. 1889.
= **Geopyxis striatospora** Maubl. & Roger, in Roger - Bull. Trimestriel Soc. Mycol. France 52: 83. 1936. Holotype: ? On leaves (host not specified), Ivory Coast (Africa), 1934, leg. A. Mallamaire. Synonymy *fide* Maublanc & Roger (1938).

The study of two additional African specimens (village of Yallinga, 1922, leg. G. Le Testu) led the French authors to conclude that the whole set of the then available specimens represent a single taxon.

This taxonomic decision was, however, not reported later by Denison (1967).

⇒ *Gibbera caespitosa* (Wint.) E.Müller, in Müller & von Arx - Die Gattungen der didymosporen Pyrenomyceten: 424. 1962.
Basionym: *Parodiella caespitosa* Wint. - Grevillea 15: 87. 1887.
= **Maireella bertioïdes** (Sacc. & Berl.) Maubl. - Arch. Bot. (Paris) 2: 128. 1928.
Basionym: *Lizonia bertioides* Sacc. & Berl. - Rev. Mycol. (Toulouse) 7: 137. 1885. On living leaves of *Mikania* spp., Brazil (date & leg. not specified). No corresponding material could be located. Synonymy *fide* Müller & von Arx (1962).

⇒ *Gibbera melioloides* (Rehm) Theiss. - Sydowia 16: 188. 1918.
Basionym: *Guillaridella melioloides* Rehm - Hedwigia 40: 107. 1901.
= **Maireella melioloides** (Rehm) Maubl. - Arch. Bot. (Paris) 2: 128. 1928. On living leaves of species of *Mikania* spp., Brazil; two collections are cited: from Rio de Janeiro, leg. E. Ule and from São Paulo, leg. A. Puttemans. Synonymy *fide* Müller & von Arx (1962).

⇒ **Gibberella longispora** Maubl. [as *Giberella*] - Bull. Trimestriel Soc. Mycol. France 36: 37. 1920; XXIV: 686. Holotype: PC ex Herb. INA as FB No. 135 (the packet bears the handwritten indication 'type'). On leaves of *Olyra* sp., pente des Corcovada, Rio de Janeiro, Brazil, 9 XI 1913, leg. A. Maublanc.

A second similar collection made on 15 V 1914 and numbered FB No. 221 is also available. Details of the *Fusarium* anamorph (unnamed) were also reported in the protologue.

⇒ *Lasiostemma melioloides* var. *caraçaense* (Maubl.) Farr - Mycologia 71: 252. 1979.
Basionym: **Dimeriella caraçaensis** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 34. 1920; XXIV: 247. Holotype: PC ex Herb. INA as FB No. 327. On living leaves of *Baccharidis* sp., Sierra de Caraça, State of Minas Gerais, 18 IX 1913, leg. A. Maublanc.

The material examined by Farr (1979) is located at FH on sheet No. 7607 of Patouillard's Herbarium. It is part of the original collection distributed by Maublanc in his series Fungi Brasiliensis. According to Farr (1979), the fungus is known only from the authentic collection.

⇒ **Hysterostomella elaeicola** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 143. 1908; XIX: 964; XXII: 556. Holotype: ? On leaves of *Elaeis guineensis*, Dahomey (date & leg. not specified).

⇒ **Laestadia multipunctata** (Went.) Maubl. - Bol. Agric. (São Paulo) 16: 312. 1915; not reported in Reed & Farr (1993).
Basionym: *Physalospora multipunctata* Went. - Grevillea 15: 88. 1886-7; IX: 596; XII: 566.

The fungus was observed developing on leaves of *Mikania* spp. No representative material could be located.

⇒ **Leptosphaeria alpiniae** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 89. 1905; XIX: 1095; XXII: 229. Holotype: PC ex Herb. SCPV No. 1580. On leaves of *Alpinis nutantis*, Botanical Garden, São Paulo, Brazil, leg. A. Puttemans (*sub* No. 466).

The fungus has apparently not been reassessed (Crane & Shearer, 1991).

⇒ **Leptosphaeria ephedra** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 88. 1905; XIX: 1101; XXII: 227. Holotype: PC ex Herb. INA, same material as for *Anthostomella distachya* Maubl. *loc. cit.*, but such is not mentioned on the packet. On dead branches of *Ephedra distachya*, in the sand dunes around the river mouth at Le Cormeu (Loire-Inférieure), France, IV 1904, leg. A. Maublanc.

The fungus has apparently not been reassessed (Crane & Shearer, 1991).

⇒ **Leptosphaeria lauri** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 89. 1905; XIX: 1105; XXII: 220. Holotype: PC ex Herb. SCPV No. 1709. On leaves of *Laurus nobilis*, département Seine-et-Marne, France (date ?), leg. A. Maublanc. According to Maublanc (1905), the fungus was accompanied by a *Phyllosticta* having oval spores, 6 x 3 µm, then believed to represent the anamorphic state.

This binomial was listed without any annotation by Crane & Shearer (1991).

⇒ **Leptosphaeria paraguayensis** Maubl. - Bol. Agric. (São Paulo) 16: 315. 1915; Bull. Trimestriel Soc. Mycol. France 36: 35. 1920; XXIV: 980. Holotype: PC ex Herb. Museo Rio de Janeiro No. 552 e, same material as for *Sphaerella ilicicola* Maubl. On leaves of *Ilex paraguayensis* near spots of *Cercospora ilicicola* (date & leg. not specified). The binomial was listed without any comment by Crane & Shearer (1991).

⇒ **Leptosphaeria puttemansii** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 88. 1905; XIX: 1110; XXII: 219. Holotype: PC ex Herb. SCPV No. 1598. On leaves of *Eriobotrya japonica*, Botanical Garden, São Paulo, Brazil, leg. A. Puttemans. On the packet, the following is mentioned: leg. A. Puttemans (Exsic. C. Roumeguère).

The name was listed without comment by Crane & Shearer (1991).

⇒ **Meliola lippiae** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 291. 1903; XVII: 546; XX: 62. Holotype: ? On the upper leaf surface of a *Lippa* sp., Dahomey, Africa (date ?), leg. G. Le Testu. The taxon was retained as valid by Hansford (1961).

⇒ *Melioliphila coralloïdes* (Maubl.) Rossman - Mycotaxon 8: 500. 1979; Mycol. Pap. 150: 95. 1983.

= *Paronectria coralloïdes* (Maubl.) Hansford - Mycol. Pap. 15: 130. 1946.
Basionym: **Calonectria coralloïdes** Maubl., in Maublanc & Rangel - Bol. Agric. (São Paulo) 16: 315. 1915; Bull. Trimestriel Soc. Mycol. France 36: 37. 1920; XXIV: 679. Lectotype: FH ex Herb. Museo Rio de Janeiro No. 640; isotype PC ex Herb. INA as FB No. 353. On immature ascomata of a *Meliola* sp. developing on leaves of a plant belonging to family *Melastomataceae*, *socio Trichothyrium fimbriatum* Speg. (?), Rio de Janeiro, Brazil, XII 1912, leg. A. Maublanc & E. Rangel.

The second specimen cited by Maublanc (1920) now filed in PC ex Herb. INA as FB No. 353 is labelled: On leaves of *Clidemia hirta*, developing over the mycelium of *Meliola melastomacearum,* in association with *Trichothyrium fimbriatum* Speg. (?), Rio de Janeiro, Brazil, 8 XII 1913, leg. A. Maublanc.

Rossman (1979) examined a duplicate of Herb. Museo Rio de Janeiro No. 640 found in Patouaillard's herbarium at FH and designated a lectotype.

⇒ **Metasphaeria stromaticola** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 34. 1920; XXIV: 959. Holotype: Herb. Museo Rio de Janeiro *sine num*. On leaf petioles of a plant belonging to the family *Sapindaceae* parasitising stromata of a *Phyllachora* sp. (? *P. duplex*), Jacarepanga, Rio de Janeiro, (date ?), leg. Dr. Britto.

⇒ **Microsphaera alphitoïdes** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 28: 100. 1912; Braun - The Powdery Mildews (Erysiphales) of Europe: 174. 1995; not reported in Reed & Farr (1993).
Anamorph: **Oidium alphitoides** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 26: 132. 1910; *nom. ill.*, Art. 34.1b. Holotype: ? On *Quercus ruber*, Gard, France, XII 1910.

For other synonyms of the anamorph, see Braun (1995).

⇒ **Morenoina inaequalis** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 40. 1920; XXIV: 430, then erroneously indicated as Maublanc & G.Arnaud.
Basionym: *Morenoina inaequalis* Maubl., in Arnaud - Ann. Ecole Natl. Agric. Montpellier, N.S., 16: 139. 1918; *nom. ill.* Art. 34.1b. Holotype: ?. On living leaves of a plant family *Myrtaceae*, pentes des Corcovado, Rio de Janeiro, 8 II 1914, leg. A. Maublanc (FB No. 296 but having the No. 295 in Maublanc, 1920).

⇒ *Mycosphaerella caricae* H. & P. Sydow - Sydowia 11: 403. 1903; Corlett - An annotated list of the published names in *Mycosphaerella* and *Sphaerella*: 59. 1991.
= *Mycosphaerella caricae* (Maubl.) Hansford - Proc. Linn. Soc. London 153: 22. 1941; *nom. ill.*, Art. 64.1.
Basionym: **Sphaerella caricae** Maubl. - Bull. Trimestriel Soc. Mycol. France 29: 358. 1913; XXIV: 855. Holotype: ? On living leaves of *Carica papaya* in Central and South America.

No particular specimen was specifically designated by the author. Also according to Maublanc (1913), *Asperisporium caricae* (Speg.) Maubl. is the corresponding anamorph.

Phoma caricae-papayae (Tarr) Punithalingam (Punithalingam, 1980) was proposed as a new name for *Phoma caricae* (Pat.) Punithalingam (CMI Description of Pathogenic Fungi and Bacteria, No. 634. 1980). However, it was not then indicated that the fungus is the anamorph of *Mycosphaerella caricae* H. & P. Sydow, the connection having not been proven experimentally. *Asperisporium caricae* (Speg.) Maubl. is also not discussed by Punithalingam (1980).

⇒ *Mycosphaerella ilicicola* (Maubl.) M.Morelet - Bull. Soc. Sci. Nat. Archéol. Toulon Var 176: 7. 1968; Corlett - An annotated list of the published names in *Mycosphaerella* and *Sphaerella*: 138. 1991; non *M. ilicicola* (Maubl.) Tomilin - Nov. Sist. Niz. Rast. 6: 120. 1969; a superfluous combination.
Basionym: **Sphaerella ilicicola** Maubl, in Maublanc & Rangel [as *illicicola*] - Bol. Agric. (São Paulo) 16: 313. 1915; Maublanc - Bull. Trimestriel Soc. Mycol. France 36: 34. 1920; XXIV: 850; XXIV: 850. Holotype: Herb. Museo Rio de Janeiro No. 552 c, *socio Cercospora ilicicola* Maubl. & *Leptosphaeria paraguayensis* Maubl, *fide* Maublanc & Rangel (1915). On white leaf spots of *Ilex paraguayensis*, southern Brazil, VII 1912 (leg. ?), Herb. Museo Rio de Janeiro No. 552 c.

⇒ *Mycosphaerella tabacii* (Maubl.) L.E.Miles [as *tabaci*] - Trans. Illinois State Acad. Sci. 10: 250. 1917; Corlett - An annotated list of the published names in *Mycosphaerella* and *Sphaerella*: 264. 1991; non *M. tabaci* (Maubl.) Tomilin - Nov. Sist. Niz. Rast. 8: 152. 1971, a superfluous combination, republished again in Oprodelitel'gribov roda *Mycosphaerella* Johans.: 256. 1979.
Basionym: **Sphaerella tabaci** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 142. 1908; XX: 828; XXII: 136, 883. Holotype: ?; same material as for *Phoma nicotiana* Maubl., also not available under this binomial. On twigs of *Nicotiana tabacum*, village of Razac (Dordogne), France (date ?), leg. A. Maublanc.

⇒ **Nectria badia** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 35. 1920; XXIV: 653. Holotype: ? On leaves of a plant of the family *Sapindaceae*, locality of Niteroy, Rio de Janeiro, State of Minas Gerais, Brazil (date ?), leg. A. Maublanc (FB No. 337).

⇒ **Phyllachora maydis** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 72. 1904; XVII: 838; XX: 374. Holotype: PC ex Herb. INA, same material as for *Coniothyrium phyllachora* Maubl. and filed under that name. On leaves of *Zea mays*, Mexico (date ?), leg. Dr. Bonnansea.

The species was retained as a valid taxon by Parberry (1967) who examined a type specimen annotated 'On *Zea mays* L., from Mexico, 70 (S)'. The fungus was also recorded from the Dominican Republic, Guatemala and Puerto Rico (Parberry *l. c.*).

⇒ **Physalospora cattleyae** Maubl. & Lasnier - Bull. Trimestriel Soc. Mycol. France 20: 171. 1904; XVII: 585; XVIII: 456; XX: 392. Holotype: PC ex Herb. INA. On dead leaves of *Cattleya mossia*, in greenhouses, close to Paris, France, 1904, leg. A. Maublanc.

The second available specimen is reported to have been collected in January 1905. Both packets are labelled: forme *gloeosporium G. macropus* Mangin (but should be read instead '*G. macropus* Sacc. *fide* Mangin').

In their publication, Maublanc & Lasnier (1904) stressed the accompanying *Gloeosporium* conidial state deviates from *G. macropus* Sacc. as suggested by Mangin (*l. c.*) but they refrained from naming the anamorph. However, according to von Arx (1970) and based on the type specimen, *Gloeosporium macropus* Sacc. represents the *Colletotrichum* conidial state of *Glomerella cingulata*.

⇒ **Physalospora populina** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 141. 1908; XX: 394; XXII: 86. Holotype: PC ex Herb. SCPV No. 1038 (labelled 'type') and PC ex Herb. INA, labelled *pars ex typo*. On dead branches of Caroline poplar (*Populus canadensis*), around Toulouse City, France, II 1906, leg. A. Maublanc (?).

⇒ **Pleospora evonymella** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 292. 1903; XVII: 749; XX: 437. Holotype: PC ex Herb. SCPV No. 2076; isotype PC ex Herb. INA. On living leaves of *Evonymus japonicus*, Pornic (Loire-Inférieure), France, IV 1903, leg. A. Maublanc.

The fungus was recognized as a valid taxon by Wehmeyer (1961) in his treatment of the genus *Pleospora* Rabenh. ex Ces. & De Not.

⇒ **Pleospora halimi** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 89. 1905; XX: 438; XXII: 269. Holotype: PC ex Herb. SCPV No. 2082; isotype PC ex Herb. INA. On branches of *Atriplex halimus*, Pornic (Loire-Inférieure), France, IV 1904, leg. A. Maublanc.

On packet No. 2082, the following has been added with a typewriter: leg. Exc. C. Roumeguère. Maublanc (1905) indicates having observed this ascomycete in association with *Coniothyrium halimi* Maubl. (then collected for the second time) which he considered to represent the relevant anamorph.

Regarding this *Pleospora*, Wehmeyer (1961) stressed the provided description rather recalls *P. pellita* (Fr.) Tul.

The fungus thus awaits to be reassessed.

⇒ **Pleospora kentiae** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 291. 1903; XVII: 754; XX: 440. Holotype: ?. On living leaves of a *Kentia* sp., Algeria, (date & leg. not specified).

Following the protologue, the relevant type material should also be the same as for *Ascochyta kentiae* Maubl. and *Stagonospora kentiae* Maubl. (PC ex Herb. SCPV No. 5811); but only the latter name is reproduced on the specimen of *Ascochyta kentiae*.

According to Wehmeyer (1961), Maublanc's description suggests an intermediate spore type placed in *Pleospora lactucicola*. Ellis & Everh.

⇒ **Pleospora polymorpha** Maubl. [as *polymorpka*, a typographic error] - Bull. Trimestriel Soc. Mycol. France 19: 291. 1903; XVII: 757; XX: 443. Holotype: Herb. SCPV No. 2144; isotype PC ex Herb. INA. In panicles of *Gynericum argenteum*, Pornic (Loire-Inférieure), France, IV 1903, leg. A. Maublanc.

According to Wehmeyer (1961), the description suggests a form of *Pleospora herbarum* (Pers.) Rabenh.

⇒ **Plowrightia agaves** (Maubl.) Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 143. 1907; XXII: 430.
Basionym: *Hypocrea agaves* Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 292. 1903; XVII: 802; XIX: 940. Holotype: PC ex Herb. SCPV No. 725. On leaves of an *Agave* sp, Mexico (date & leg. not specified).
= *Plowrightia williamsoniana* Kellerm. - Journal of Mycology 12 (85): 185. 1906. Synonymy *fide* Maublanc (1907).

⇒ **Schizoxylon yuccae** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 72. 1904; XVIII: 154; XX: 754. Holotype: ? On dead leaves of *Yucca gloriosa*, Pornic (Loire-Inférieure), France, 1903, leg. A. Maublanc.

The binomial was not considered by Sherwood (1977a & 1977 b) in her treatment of ostropalean fungi.

⇒ **Sphaerostilbe polycephala** Maubl. & Roger, in Roger - Bull. Trimestriel Soc. Mycol. France 50: 330. 1934. Holotype: ? On bark of an unknown tree, around Douala, Cameroon, Africa (date ?), leg. Aubert (then Director of the Pathology Laboratory of Douala).

⇒ **Theissenia pyrenocrata** (Theiss.) Maubl. - Bull. Trimestriel Soc. Mycol. France 30: 52. 1914; XXIV: 1092.
Basionym: *Ustulina pyrenocrata* Theiss. - Sydowia 6: 347. 1908. XXII: 334.
The fungus developed on a specimen of a tree bark covered with a thick dark fungal crust at the School of Agriculture Luiz de Queiroz at Piracicaba, State of São Paulo, Brazil (date ?); material sent by G. Bondar. The tree is known locally by the common name 'Minjoleiro' (? *Enterolobium monjollo*). However, no corresponding material could be located.

To accomodate this species, the new genus *Theissenia* was proposed and named after the author of the basionym, F. Theissen, a German clergyman and amateur mycologist. This unispecific genus remains undocumented since its proposal (Hawksworth *et al.*, 1995).

⇒ **Uropolystigma atro-testaceum** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 36. 1920; XXIV: 644. Holotype: PC ex Herb. INA. On living leaves of a plant of the family *Malpighiaceae*, Ouro Preto (FB Nos. 181 & 321), Caraça (No. 342), State of Minas Gerais, Brazil (date ?), leg. A. Maublanc. .

This is the type species of the still unispecific and undocumented genus *Uropolystigma* Maubl. (Hawksworth *et al.*, 1995).

⇒ **Valsaria (Eu-Valsaria) spartii** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 88. 1905; XX: 1120; XXII: 391. Holotype: PC ex Herb. SCPV No. 1810; isotype PC ex Herb. INA. On branches of *Spartium junceum*, Pornic (Loire-Inférieure), France, IV 1904, leg. A. Maublanc.

⇒ ***Vizella hieronymi*** Wint. var. **coffeae** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 71. 1904; XVII: 861; XX: 1135. Holotype: ? On leaves of *Coffea* sp., Mexico (date ?)., leg. Herrera.

BASIDIOMYCETES

⇒ **Aecidium pergulariae** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 87. 1905; XXI: 776. Holotype: PC ex Herb. SCPV No. 3509. On leaves of *Pergularia africana*, Adja Ouéré, Dahomey, 28 III 1902, leg. G. Le Testu.

A more elaborate description was later provided by Viennot-Bourgin [(1958) 1959] from material developing on *Pergularia extensa* at Popué Boka, near the village of Annékrou, Ivory Coast; but then the original publication date was erroneously reported as 21: 87. 1906.

⇒ **Hemileia coffeicola** Maubl. & Roger - Bull. Trimestriel Soc. Mycol. France 50: 198. 1934; Laundon & Waterston - CMI Description of Pathogenic Fungi and Bacteria No. 2. 1964. Holotype: PC ex Herb. INA. On leaves of *Coffea arabica*, Dschang, Cameroon, X-XI 1933, leg. L. Gérin *via* Aubert (type).

= **Uredo coffeicola** Maubl. & Roger - Compt. Rend. Acad. Sci., Paris 198: 1069. 1934, proposed *ad interim*; *nom. ill.*, Art. 34.1b. The second available specimen also bears the same labelling.

The history and distribution of this rust on several *Coffea* species in Africa was reviewed by Laundon and Waterston (1964).

⇒ **Hemileia gardeniae-thunbergiae** Maubl. & Roger - Bull. Trimestriel Soc. Mycol. France 50: 202. 1934.
= *Uredo gardeniae-thunbergiae* Henn. - Bot. Ergebn. der kunene-Sambesi Exped.: 160. 1902; XVII: 440. Synonymy probably proposed without examination of authentic material.

The specimen examined by Maublanc & Roger (1934) was filed in PC under the binomial *Uredo gardeniae-thunbergiae*. It had the following characteristics: On leaves of *Gardenia thunbergia*, Tchibanga, Gabon, 1907, leg. G. Le Testu.

Unfortunately, this African specimen is no longer available in PC either under the generic epithet *Uredo* or *Hemileia*. It is possible the French authors did not examine authentic material of *Uredo gardeniae-thunbergiae*. Further as Hennings described only uredinia, his species cannot be considered as a basionym as suggested by Maublanc & Roger (1934).

⇒ **Hemileia pavetticola** Maubl. & Roger, in Roger - Bull. Trimestriel Soc. Mycol. France 54: 51. 1938. Holotype: ? On living leaves of *Pavetta ternifolia*, Kigali, Rwanda, 1936, leg. Molitor.

⇒ **Omphalia flavida** Maubl. & Rangel - Compt. Rend. Acad. Sci., Paris 157: 859. 1913; Bull. Trimestriel Soc. Mycol. France 30: 46. 1914; XXIII: 111. Holotype: ? On leaves of *Eriobotrya japonica* and on plants belonging to families *Melastomaceae*, *Compositae* and *Rubiaceae*, close to Rio de Janeiro, Brazil, (date ?), leg. E. Rangel; associated with *Stilbum flavidum* Cke, the abortive form.

⇒ **Puccinia letestui** Maubl. [as *Le Testui*] - Bull. Trimestriel Soc. Mycol. France 22: 71. 1906; XX: 1294; XXI: 641. Holotype: PC ex Herb. SCPV No. 3393. On leaves of *Vernonia* sp., Marromen, Portuguese East Africa (Moçambique), 1 X 1904, leg. G. Le Testu.

⇒ *Puccinia oxalidis* Diet. & Ell. - Hedwigia 34: 291. 1895; XI: xv; XII: 638; XIV: 296; XX: 609.
= *Aecidium maublancii* Syd. - Sydowia 2: 351. 1904; XVII: 492, *nom. nov.*

Basionym: **Aecidium mexicanum** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 73. 1904; non *A. mexicanum* Diet. & Holw. - Bot. Gaz. 48: 36. 1897; XIV: 373. Holotype: ? On leaves of *Mahonia* sp., Mexico (date ?), leg. Dr. Bonnansea.

This aecial stage is now recognized as belonging to *Puccinia oxalidis* Diet. & Ellis.

⇒ *Ravenelia deformans* (Maubl.) Diet. - Beihefte Botan. Centralblatt. 20 (2): 404. 1906; Sydow P. & H. - Monographia Uredinearum III: 296. 1915.
Basionym: **Pleoravenelia deformans** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 73. 1906; XX: 1288; XXI: 745. Holotype: PC ex Herb. SCPV No. 3780. On twigs of *Acacia* sp. (? *A. arabica*), Mhalume, Portuguese East Africa (Moçambique), 11 X 1904, leg. G. Le Testu.

⇒ **Ravenelia letestui** Maubl. [as *Le Testui*] - Bull. Trimestriel Soc. Mycol. France 22: 72. 1906; XXI: 739; Sydow P. & H. - Monographia Uredinearum III: 267. 1915. Holotype: PC ex Herb. SCPV No. 3781. On living leaves of *Cassia* sp., Marral, Portuguese East Africa (Moçambique), 25 VIII 1904 (not 1905 as indicated in the publication), leg. G. Le Testu.

⇒ *Uredo behnickiana* Henn. - Hedwigia 44: 169. 1905; XXI: 803.
= **Hemileia oncidii** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 138. 1909; XX: 1249; XXI: 599. Holotype: ? On living leaves of several Brazilian orchids: *Oncidium marschallianum*, *O. crispum* and *O. varicosum* var. *rodgersii*, in greenhouses close to Paris, France, winter 1908-9, leg. A. Maublanc. Synonymy *fide* Sydow P. & H. (1915).

The original protologue only dealt with uredinia and thus the name *Hemileia oncidii* is invalid.

⇒ **Ustilago bouriquetii** Maubl. & Roger, in Roger [as *bouriqueti*] - Bull. Trimestriel Soc. Mycol. France 50: 327. 1934. Holotype: PC ex Herb. INA. On leaves of *Stenotaphrum* sp. (? *complanatum*), Nanisana, Madagascar, 1931, leg. Bouriquet, det. Mlle Camus.
= *Sphacelotheca mauritana* Zundel - Mycologia 36: 405. 1944. Synonymy *fide* Vanky (1996).
= *Sorosporium stenotaphri* G.Viennot-Bourgin - Ann. Inst. Natl. Agron., Paris 47: 43. 1963, *nomen novum superfluum pro Ustilago bouriquetii* (Vanky, 1996).

Two specimens are also filed in the same collection: Herb. Bouriquet. Sur *Stenotaphrum complanatum*, Station de Nahampoana (Fort Dauphin), 15 V 1947, leg. Mallamaire and Herb. A. Maublanc; sur *Stenotaphrum*, Madagascar, Bouriquet legit 1932, Typus, but following Vanky (1996) this specimen is not the type material.

This smut was not considered by Zundel (1953) in his book on Ustilaginales of the World. A modern description was recently provided by Vanky (1996).

⇒ **Ustilago andropogonis-finitimi** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 74-75. 1906; XXI: 507. Holotype: PC ex Herb. SCPV No. 4132. In ovaries of *Hyparrhenia finitimi* [= *Andropogonis* (*Cymbopogon*) *finitima*], Portuguese East Africa (Moçambique as Zambésie), 1905, leg. G. Le Testu.

The recent discovery of the relevant authentic material allowed us to disentangle the corresponding taxonomic imbroglio that prevailed since the introduction of this binomial (Vanky & Mouchacca, in press).

DEUTEROMYCETES

⇒ **Acladium candidum** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 295. 1903; XVIII: 522; XIX: 8. Holotype: ? Developed in a saline solution, Paris, France (date & leg. not specified). The original material is apparently a contaminant culture and as such should be considered as definitely lost.

Oospora albo-cinerascens Maubl. was also described from a saline solution.

⇒ **Ascochyta kentiae** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 293. 1903; XVIII: 350; XIX: 108. Holotype: PC ex Herb. SCPV No. 5811. On living leaves of *Kentia* sp., Alger, Algeria (date & leg. not specified).

The relevant handwriting of this specimen indicates it is the same material for *Stagonospora kentiae* Maubl.; but in the publication and under this binomial, it is specified such a specimen is also the authentic material of *Pleospora kentiae* Maubl.

⇒ **Asperisporium alstroemeriae** (Allesch.) Maubl. - Lavoura 16: 212. 1913; Bull. Trimestriel Soc. Mycol. France 29: 357. 1913; the synonymy is not reported in Reed & Farr (1993).
Basionym: *Scolecothrichum alstromeriae* Allesch., in P. Hennings - Hedwigia 34: 116. 1895; XI: 618; XII: 682.

Transferred to *Asperisporium* Maubl., type species *A. caricae* (Speg.) Maubl., on account of the verrucose conidia; see also under *A. caricae*.

⇒ **Asperisporium caricae** (Speg.) Maubl. - Lavoura 16: 212. 1913; Bull. Trimestriel Soc. Mycol. France 29: 357. 1913; XXIV: 855; Ellis - Dematiaceous Hyphomycetes: 274. 1971; Ellis & Holliday - CMI Description of Pathogenic Fungi & Bacteria No. 347. 1972.
Basionym: *Cercospora caricae* Speg. - Anal. Soc. Scient. Argentine 16: 168. 1883; Chupp - A monograph of the fungus genus *Cercospora*: 106. 1954.
= *Fusicladium caricae* (Speg.) Sacc. - Atti Congr. Bot. Palermo: 58. 1902; XVIII: 580.
For other synonyms, see Ellis & Holliday (1972).

Asperisporium Maubl. was established to accomodate *Cercospora caricae* Speg., a fungus then thought to be incorrectly placed in *Cercospora* Fresen. due to the verrucose conidia. Three other taxa were then transferred for the same reason. The type species induces black spot, blight or 'rust' of papaw (*Carica papaya*). The disease is now restricted to Central and South America, the West Indies and USA (Florida); it is presumably air dispersed but not yet sufficiently documented (Ellis & Holliday, 1972).

From infected leaves of papaw, Maublanc (1913) also described *Sphaerella caricae* Maubl. (now *Mycosphaerella caricae* H. & P. Sydow) which he believed to be the teleomorph.

The authentic material of *Cercospora caricae* Speg. is from Paraguay (B. Balansa No. 2739, February 1881).

⇒ **Asperisporium punctulatum** (Tracy & Earle) Maubl. - Lavoura 16: 212. 1913; Bull. Trimestriel Soc. Mycol. France 29: 357. 1913; the synonymy is not mentioned in Reed & Farr (1993).
Basionym: *Scolecotrichum punctulatum* Tracy & Earle - Bull. Torrey bot. club 25: 178. 1895; XIV: 1078.

Transferred to *Asperisporium* Maubl. on account of the verrucose conidia.

⇒ **Botryodiplodia digitata** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 294. 1903; XVIII: 334; XIX: 182; Zambettakis - Bull. Trimestriel Soc. Mycol. France 70: 311. 1954. Holotype: PC ex Herb. SCPV No. 6137. In pseudobulbs of *Cattleyae mossiae*, in a greenhouse close to Paris (Fontenay-aux-Roses), France (date and leg. not specified).

The species was retained as a valid taxon by Zambettakis (1954) upon examination of the exsiccata then maintained at the 'Station Centrale de Pathologie Végétale de Versailles'. No modern description of this species of *Botryodiplodia* (Sacc.) Sacc. could be traced.

⇒ **Camarosporium halimi** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 294. 1903; XVIII: 374; XIX: 218; XXVI: 398. Holotype: PC ex Herb. SCPV No. 6466, labelled *socio Coniothyrium atriplicis* Maubl. On twigs of *Atriplex halimum*, Pornic (Loire-Inférieure), France, IV 1903, leg. A. Maublanc. The original collection was divided into two parts filed under *Camarosporium halimi* and *Coniothyrium atriplicis*. Both parts are now maintained in PC as separate entities: Herb. SCPV & Herb. INA.

⇒ **Camarosporium persicae** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 144. 1907; XIX: 219; XXII: 1077. Holotype: PC ex Herb. SCPV No. 6472; isotype in PC ex Herb. INA. On dead twigs of *Persica vulgaris*, gardens of the Plant Pathology Station, Paris, France, 28 II 1906, leg. A. Maublanc. The original authentic material was divided into two parts; both are now housed in PC and maintained as separate collections.

⇒ **Camarosporium populinum** Maubl.- Bull. Trimestriel Soc. Mycol. France 21: 91. 1905; XVIII: 374; XIX: 219. Holotype: PC ex Herb. SCPV No. 6473; isotype PC ex Herb. INA. On twigs of *Populus alba*, Pornic (Loire-Inférieure), France, IV 1904, leg. A. Maublanc.

⇒ **Ceratopycnidium citricola** Maubl. [as *citricolum*] - Bull. Trimestriel Soc. Mycol. France 23: 148. 1907; XIX: 244 ; XXII: 1034. Holotype: ? Developed on the secretions of an insect present on both sides (but most often on the upper side) of leaves of tangerine (*Citrus reticulata*) at Brazzaville, Congo (date ?), leg. Ph. de Vilmorin.

Ceratopycnidium Maubl. was introduced to accommodate a single species. The genus was renamed *Ceratopycnium* by Clements & Shear (1931), a superfluous *nomen novum* (Sutton, 1977). The original African material is so far the only known record of the fungus (Bertoni & Cabral, 1991).

Recently a second species was introduced by Bertoni & Cabral (1991): *Ceratopycnidium baccharidicola*, on *Baccharis coridifolia* in Argentina. But these authors were unable to study the holotype 'since the author (Maublanc) indicated not where it was deposited'. Bertoni and Cabral then stressed the description and the original iconography provided are ‘so detailed that it is possible to interpret conidiogenesis in the type species as being holoblastic with sympodial development of holoblastic conidiogenous cells’. Accordingly they proposed to emend the genus as having ‘holoblastic conidia being hyaline, smooth, ellipsoid to cylindric, 0-3 euseptate, sometimes constricted at the septa’.

⇒ **Cercospora byrsonimatis** Maubl. - Bull. Trimestriel Soc. Mycol. France 36: 40. 1920; Chupp - A monograph of the fungus genus *Cercospora*: 365. 1954. Holotype: PC ex Herb. INA as FB No. 180.
= *Cercosporina byrsonimatis* (Maubl.) Sacc. - *Syll. Fung.* XXV: 910. 1931. On living leaves of *Byrsonema* sp., Belo Horizonte, State of Minas Gerais, Brazil, 8 IX 1913, leg. A. Maublanc.

Spegazzini (1910) introduced the genus *Cercosporina* to segregate species of *Cercospora* Fresen. with hyaline conidia. However as the type species of the latter genus possesses the same character, the new generic proposal is thus superfluous (Chupp, 1954). Transfers to *Cercosporina* subsequently made by Saccardo were accordingly not reported by Chupp (1954). Later, Sutton & Pons (1980) re-examined the lectotype species *Cercosporina asparagicola* Speg. and decided the fungus should better be retained in *Cercospora*, a decision in line with Chupp’s proposal.

The recent discovery of authentic material initiated the preparation of a modern description of this Brazilian hyphomycete (Braun & Mouchacca, in press).

⇒ **Cercospora ilicicola** Maubl., in Maublanc & Rangel - Bol. Agr. (São Paulo) 16: 321-322. 1915; Bull. Trimestriel Soc. Mycol. France 36: 41. 1920; Chupp - A monograph of the fungus genus *Cercospora*: 52. 1954. Holotype: ?; probably in Herb. Museo Rio de Janeiro under No. 552; no specimen in PC. On living leaves of *Ilex paraguayensis*, Parana, Brazil, VII 1912, leg. E. Rangel No. 552.
= *Cercosporina ilicicola* (Maubl.) Sacc. - *Syll. Fung.* XXV: 896. 1931.

The transfer to *Cercosporina* Speg. was refuted by Chupp (1954).

⇒ *Cercospora traversiana* Sacc. - Sydowia 2: 18. 1904; Chupp - A monograph of the fungus genus *Cercospora*: 338. 1954.
= **Cercospora trigonellae** Maubl., in Maublanc & Rangel - Bol. Agric. (São Paulo) 16: 322. 1915; Maublanc - Bull. Trimestriel Soc. Mycol. France 36: 41. 1920. Holotype: ?; probably in Herb. Museo Rio de Janeiro; isotype PC (Herb. INA) as FB No. 325. On living leaves of *Trigonella foenum-graecum*, Pinheiro, Rio de Janeiro, Brazil, 1913, leg. E. Rangel No. 775. Synonymy *fide* Chupp (1954).
= *Cercosporina trigonellae* (Maubl.) Sacc. - *Syll. Fung.* XXV: 908. 1931.

In his second note on the same fungus, Maublanc (1920) refers to the exsiccata No. 325 of his series Fungi Brasiliensis: On living leaves of *Trigonella foenum-graecum*, Rio de Janeiro, Brazil, 18 VII 1912, leg. A. Maublanc.

⇒ *Chaetasbolisia erysiphoïdes* (Griffon & Maubl.) Speg. - Physis 4: 293. 1918; XXV: 179; Sutton - The Coelomycetes: 366. 1980.
Basionym: **Chaetophoma erysiphoïdes** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 60. 1909; XXII: 937. Holotype: ? On living leaves of *Quercus ilicis*, Cadillac (Gironde), France, (date ?), leg. Capus.

The specific epithet refers to the general appearance of the fungus recalling an Erysiphale. According to Sutton (1980), the type species of *Chaetasbolisia* Speg. was redescribed by Batista & Ciferri (1963) but not through an examination of authentic material.

⇒ *Colletotrichum gloeosporioides* Penz. - Fungi. Agrum. 2: 6. 1882; von Arx - Bibl. Mycol. 24: 59. 1970.

= **Gloeosporium dendrobii** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 68. 1906; XXII: 1192. Holotype: PC ex Herb. SCPV No. 7070. On leaves of *Dendrobium farneri*, in a greenhouse, close to Paris, France (date ?), leg. A. Maublanc. Synonymy *fide* von Arx (1970).

= **Gloeosporium hedericolum** Maubl. [as *hedericola*] - Bull. Trimestriel Soc. Mycol. France 20: 71. 1904; XVIII: 452; XIX: 772. Holotype: PC ex Herb. SCPV No. 7081. On living leaves of *Hedera helix*, Monfort-l'Amaury (close to Paris), France (date ?), leg. Mlle Belèze. Synonymy *fide* von Arx (1970).

= **Gloeosporium phaji** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 67. 1906; XXII: 1191. Holotype: PC ex Herb. SCPV No. 7104. On living leaves of *Phajum* sp., in a greenhouse, close to Paris, France, leg. A. Maublanc. Synonymy *fide* von Arx (1970).

= **Gloeosporium ricini** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 67. 1906; XXII: 1186. Holotype: PC ex Herb. SCPV No. 7112 as A. Puttemans - Fungi S. Paulensis No. 518. On senescent leaves of *Ricinus communis*, Botanical Garden, São Paulo, Brazil, I 1905, leg. A. Puttemans. Synonymy *fide* von Arx (1970).

= **Gloeosporium sobraliae** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 68. 1906; XXII: 1192. Holotype: PC ex Herb. SCPV No. 7114. On leaves of *Sobralia* sp., in a greenhouse, close to Paris , France (date ?), leg. A. Maublanc. Synonymy *fide* von Arx (1970).

Von Arx (1970) based his conclusions upon comparison of the provided protologues. Re-examination by the present authors of the discovered authentic material has confirmed the proposed synonymies.

⇒ **Coniothyrium atriplicis** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 293. 1903; XVIII: 305. XIX: 397. Holotype: PC ex Herb. INA, specimen labelled *socio Camarosporium halimi* Maubl. On twigs of *Atriplex halimi*, Pornic (Loire-Inférieure), France, IV 1903, leg. A. Maublanc. The original collection was divided into two parts filed under *Camarosporium halimi* and *Coniothyrium atriplicis*. Both parts are now maintained as separate collections in PC.

The species has apparently been overlooked since its description (Sutton, 1980).

⇒ **Coniothyrium phyllachorae** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 72. 1904; XVIII: 308; XIX: 400. Holotype: PC ex Herb. SCPV No. 6332; isotype PC ex

Herb. INA; same authentic material as for *Phyllachora maydis* Maubl. Observed developing on ascomata of *Phyllachora maydis* Maubl. growing on leaves of *Zea mays*, Mexico (date ?), leg. Dr. Bonnansea. The original collection was divided into several parts to represent authentic material of this fungus and that of *Phyllachorae maydis*. Parts are now maintained in separate collections at PC.

⇒ **Coryneum modonium** (Sacc.) Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 26: 379. 1910; Sutton - The Coelomycetes: 354. 1980; the synonymy is not reported in Reed & Farr (1993).
Basionym: *Stilbospora modonia* Sacc. - *Syll. Fung*. III: 772. 1884; XII: 764; XX: 1351.
Teleomorph: *Pseudovalsa modonia* (Tul.) Höhn. - Sydowia 16: 125. 1918.
Basionym: *Melanconis modonia* Tul. - Selecta Fungor. Carpol. 2, tab. 15, figs. 1-6, 1865; I: 603; XII: 416; XX: 43.

Examination of infected twigs of *Castanea* sp. in the Limousin area (France), led Griffon and Maublanc to transfer the anamorph of this fungus to *Coryneum* Nees.
A modern description is provided by Sutton (1980).

⇒ **Cytospora unedonis** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 71. 1904; XVIII: 300; XIX: 532. Holotype: PC ex Herb. SCPV No. 5371; isotype PC ex Herb. INA. At the tip of dry leaves of *Arbutus unedo* (Arbousier), Pornic (Loire-Inférieure), France, IV 1903, leg. A. Maublanc.

⇒ **Cytosporina halimi** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 144. 1907; XXII: 1139. Holotype: PC ex Herb. SCPV No. 6488. On dead twigs of *Atriplex halimum*, Pornic (Loire-Inférieure), France, (date ?), leg. A. Maublanc.

⇒ **Dichomera carpinii** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 59-60. 1909; XXII: 1085. Holotype: PC ex Herb. SCPV No. 6480. On dead branches of *Carpinus betulus*, Bigny-sur-Arroux (Saône-et-Loire), 1908, leg. Flageolet.

⇒ *Diplodia inconspicua* Cooke - Grevillea 13: 96. 1885-6; IVA: 327; X: 284; XII: 210; Zambettakis - Bull. Trimestriel Soc. Mycol. France 70: 261. 1954 [as *inconspiqua*, a typographic error].
= **Diplodia abiegna** Maubl. - Bull. Trimestriel Soc. Mycol. France 15: 294. 1903. Holotype: PC ex Herb. SCPV No. 6144. On living leaves of *Abiei concolor*, close to Paris (Chatenay, Seine-et-Oise), France (date ?), leg. A. Maublanc. Synonymy *fide* Zambettakis (1954).
= *Microdiplodia abiegna* (Maubl.) Sacc. & D.Sacc. - *Syll. Fung*. XVIII: 327. 1906.

⇒ **Fusicladium butyrospermi** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 29: 249. 1913; XXV: 803. Holotype: ?; indicated as being the same material as for *Pestalozzia heterospora* Maubl., also not available under this name. On living leaves of *Butyrospermum parkii*, Koulikoro, Haut-Sénégal and Niger (date ?), leg. Vuillet.

⇒ **Helminthosporium lycopersici** Maubl. & Roger, in Roger - Bull. Trimestriel Soc. Mycol. France 52: 84. 1936; *nom. inval.*, Art. 36.1. Holotype: ? On living leaves of

Lycopersicon esculentum, La Mé, Ivory Coast (Africa), 26 IX 1932, leg. A. Mallamaire.

The species was proposed because no *Helminthosporium* had, at that time, been observed on tomato plants.

⇒ **Lasiodiplodia theobromae** (Pat.) Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 57. 1909; XXIV: 770; Punithalingam - CMI Description of Pathogenic Fungi & Bacteria No. 519. 1976 [as *Botryodiplodia theobromae* Pat.]; Sutton - The Coelomycetes: 191. 1980.
Basionym: *Botryodiplodia theobromae* Pat. - Bull. Trimestriel Soc. Mycol. France 8: 136. 1892; XI: 522; XII: 56; XXII: 1011. Holotype: FH No. 9410, collected in San Domingo de Colorado, Ecuador.
= **Chaetodiplodia arachidis** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 91. 1905; XVIII: 330; XIX: 261. Holotype: PC ex Herb. SCPV No. 6143. On stems of *Arachis hypogea* grown at the Plant Pathology Station, Versailles, France (date ?), leg. A. Maublanc. Synonymy *fide* Zambettakis (1954).

Teleomorph: *Botryosphaeria rhodina* (Berk. & Curtis) von Arx - The genera of fungi sporulating in pure culture (Lehre): 143. 1970.
Basionym: *Physalospora rhodina* Berk. & Curtis, in Cooke - Grevillea 17: 92. 1889.

This facultative wound pathogen induces numerous diseases either alone or in association with other primary invaders. Worldwide in distribution between latitudes 40° N & 40° S of the equator (Farr *et al.*,1989).

In 1981, von Arx reconsidered his former opinion about the taxonomic position of the fungus which he relocated again in *Botryodiplodia* Sacc. But this disposition did not receive wide agreement (Farr *et al.*, 1989).

⇒ **Lasiostroma pirorum** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 27: 472. 1911 (not 1912 as indicated in Reed & Farr, 1993); Ann. Inst. Natl. Agron., Paris, sér. 2, 10: 100. 1911; XXV: 509. Holotype: ? On discolored fruits of *Pyrus communis* forming large necroses, Paris (date ?), leg. A. Maublanc.

According to Sutton (1977) in spite of the description which included '*Stromata…externe pilosa, pilis septatis, filiformibus*' it seems clear that the type and only species of *Lasiostroma* Griffon & Maubl. is a *Phomopsis*. The conidia were referred to as hyaline, continuous, ovoid or fusiform, both ends obtuse, biguttulate, 5 - 8 x 2 - 3 µm issuing in a cirrhus. Conidiophores were described as elongated, aciculate, 20 - 25 µm long. The stromatic tomentose fructifications and conidial and conidiophore features indicate *Phomopsis* to be the most likely genus. The absence of any illustration precludes a definite conclusion.

Sutton (1977) was apparently unaware of the second paper published on the same topic by Griffon and Maublanc (1911) and which contains three illustrations of the fungus (Figs. 8 - 10). Later, Sutton (1980) cited this form genus as a synonym of *Phomopsis* (Sacc.) Sacc. but still without debating the relevant type species.

⇒ *Macrophoma maublancii* Sacc. & D.Sacc. - *Syll. Fung.* XVIII: 273. 1906; *nom. nov.*
Basionym: **Macrophoma ulmicola** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 70-71. 1904; non *M. ulmicola* Dearn. - Mycologia 9: 353. 1917; XXV: 159. Holotype:

PC ex Herb. INA. On living leaves of probably *Ulmus campestris*, Le Croisic (Loire-Inférieure), France, VIII 1913, leg. A. Maublanc.

No modern description of this fungus is available (Sutton, 1980).

⇒ *Marssonina obtusata* (Maubl.) Mouch., comb. nov.
Basionym: **Marssonia obtusata** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 69. 1906; XX: 1269; XXII: 1211. Holotype: PC ex Herb. SCPV No. 7017. On living leaves of probably *Daphne laureola*, close to Alençon, France (date ?), leg. Lemée.

Marssonina Magnus has been conserved against *Marssonia* J.C. Fisch. but not all names of the latter were reassessed (Hawksworth *et al.*, 1995).

⇒ **Melanobasidium mali** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 70. 1906; XX: 1270; XXII: 1491. Holotype: ? On living leaves of *Pyrus malus*, Seville, Spain (date & leg. not specified). Type species of the unispecific genus *Melanobasidium* Maubl., a genus later renamed *Melanobasis* by Clements & Shear (1931: 370), a superfluous *nomen novum*. The genus awaits to be reassessed.

⇒ *Microdiplodia depazeoïdes* (Durieu & Mont.) Zambett. - Bull. Trimestriel Soc. Mycol. France 70: 248. 1954.
Basionym: *Diplodia depazeoïdes* Durieu & Mont. - Fl. Alg.: 575. 1849; Montagne - Syll. Crypt.: 266. 1856; III: 372.
= **Diplodiella tamaricis** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 66. 1906; XXII: 1006. Holotype: PC ex Herb. INA; same material as *Calospora tamaricis* var. *zignoellides* Maubl. On dead branches of a *Tamarix* sp., Pornic (Loire-Inférieure), France, IV 1905, leg. A. Maublanc. Synonymy *fide* Zambettakis (1954).

It is not clear whether Zambettakis (1954) examined authentic material.

⇒ *Monochaetia paeoniae* (Maubl.) Sacc. & D.Sacc. - Syll. Fung. XVIII: 485. 1906.
= **Pestalotia (Monochaetia) paeoniae** Maubl. [as *Pestalozzia*] - Bull. Trimestriel Soc. Mycol. France 21: 92. 1905; non *P. paeoniae* Servazzi - Boll. Lab. Sper. R. Osserv. Fitopat. Torino 16: 35. 1938. Holotype: ? On branches of *Paeonia arborea*, close to Paris, France (date & leg. not specified).

Following Nag Raj (1993), the original description and illustration suggest the fungus might be identical to *Seimatosporium grammitum* (Berk. & Curt.) Nag Raj, but a final decision can be reached only after re-examination of type material.

⇒ *Monochaetia pinicola* Dearness - Mycologia 20 : 224. 1928.
= **Toxosporium camptospermum** (Peck) Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 173. 1907; XXII: 1219. Synonymy *fide* Sutton (1975).
Basionym: *Pestalotia camptosperma* Peck - N. Y. St. Mus. Rep. 39: 48. 1886; X: 495; XII: 502.

This fungus was encountered in the course of a study of a disease of fir trees in the Jura mountains, France. The relevant taxonomic history was detailed by Sutton (1975).

⇒ **Naemospora jasmini** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 60. 1909; XX: 1276; XXII: 1196. Holotype: ? On dead twigs of *Jasmium officinale*, Rigny-sur-Arroux (Saône-et-Loire), France (date ?), leg. Flageolet.

The genus *Naemospora* Roth ex Kunze is regarded as a *nomen dubium* and could possibly represent a mitosporic fungus (Hawksworth *et al*., 1995).

⇒ *Nomuraea rileyi* (Farlow) Samson, in Kish, Samson & Allen - J. Invertebr. Pathol. 24: 154. 1974; Samson - Stud. Mycol. 6: 81. 1974.
Basionym: *Botrytis rileyi* Farlow - Rep. U. S. Comm. Agri.: 121. 1883; not in Reed & Farr (1993).
= *Spicaria prasina* (Maubl.) Sawada - Cat. Formosan Fungi: 606. 1919.
Basionym: **Nomuraea prasina** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 296. 1903; XVIII: 533; XX: 201. Holotype: PC ex Herb. SCPV No. 7459. On larva of the insect *Pionaea forficalis* inhabiting *Brassica oleracea*, Tokyo, Japan, (date ?), leg. Nomura. Synonymy *fide* Kish *et al.* (1974).

The genus *Nomuraea* was established by Maublanc (1903) for the single entomophagous species *N. prasina* Maubl. Dedicated to Mr Nomura who had sent the original material to the Plant Pathology Station, Paris.

Kish *et al.* (1974) in the course of their study of entomophagous species of *Spicaria* Harting were unable to locate the type specimen of *Nomurea prasina.* But their examination of the protologue, representative available cultures and herbarium specimens confirmed the fungus is synonymous with *Botrytis rileyi*.

Re-examination of the disovered authentic material is in line with the relevant taxonomic conclusion formerly proposed.

⇒ **Oospora albo-cinerascens** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 295. 1903; XVIII: 498; XX: 231. Holotype: ? In a saline solution, Paris, France (date & leg. not specified). In the same publication, Maublanc also proposed the new *Acladium candidum* probably from the same saline solution. It is not clear whether both protologues were based on living cultures observed as contaminants of this solution.

⇒ **Penicillium dupontii** Griffon & Maubl. [as *duponti*]- Bull. Trimestriel Soc. Mycol. France 27: 73. 1911; XXV: 681; emend. Emerson, in Raper & Thorn - A manual of the penicillia: 573. 1949; Pitt - The Genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces*: 515. 1980. Holotype: ? ; neotype CBS 236.58 (Pitt, 1980).
Teleomorph: *Talaromyces thermophilus* Stolk - Antonie van Leeuwenhoek J. Microbiol. Serol. 31: 268. 1965; Stolk & Samson - Stud. Mycol. 2: 55. 1972; Mouchacca - Crypt., Mycol. 18: 39. 1997.

The original cultures of this thermophilic hyphomycete were isolated from manure and damp hay by Mr Dupont, then Chief Chemist at the 'Ecole Nationale d'Agriculture de Grignon (France)'. The anamorph was described exclusive of the teleomorph. The history of this anamorph-teleomorph connection was recently reviewed by Mouchacca (1997).

⇒ *Pestalotiopsis ceratoniae* (Maubl.) Ribeiro de Souza - Rodriguésia 37 :22. 1985.
Basionym: **Pestalotia ceratoniae** Maubl. [as *Pestalozzia*] - Bull. Trimestriel Soc. Mycol. France 21: 92. 1905; XVIII: 480; XX: 302. Holotype: ? On living leaves of *Ceratonia siliqua*, Botanical Garden, São Paulo, Brazil, leg. A. Puttemans. Relevant authentic material might be present at the Herb. Museo Rio de Janeiro.

The transfer to *Pestalotiopsis* Steyaert was admitted by Nag Raj (1993).

⇒ **Pestalotia clusiae** Griffon et Maubl. [as *Pestalozzia*] - Bull. Trimestriel Soc. Mycol. France 25: 239. 1909; XX: 302; XXII: 1219; Guba - Monograph of *Monochaetia* and *Pestalotia*: 224. 1961. Holotype: ? On living leaves of *Clusia* sp., in a greenhouse, close to Paris, France, (date ?), leg. Jardin Colonial de Nogent-sur-Marne.

Considered as a valid taxon by Guba (1961) but regarded of uncertain status by Nag Raj (1993) because no authentic material was available to him for examination.

⇒ **Pestalotia heterospora** Griffon & Maubl. [as *Pestalozzia*] - Bull. Trimestriel Soc. Mycol. France 29: 249. 1913; XXV: 606; Guba - Monograph of *Monochaetia* and *Pestalotia*: 163. 1961. Holotype: ?; same specimen as for *Fusicladium butyrospermum* Griffon & Maubl. which also could not be located. On dry blackish patches on leaves of *Butryospermum parkii*, Koulikoro, Haut Sénégal and Niger, (date ?), leg. Vuillet.

Following Nag Raj (1993), the fungus awaits to be reassessed.

⇒ *Pestalotiopsis longi-aristata* (Maubl.) Kausar - Biologia 6: 239. 1960.
Basionym: **Pestalotia longi-aristata** Maubl. [as *Pestalozzia*] - Bull. Trimestriel Soc. Mycol. France 21: 92. 1905; XVIII: 479; XX: 304; Guba - Monograph of *Monochaetia* and *Pestalotia*: 243. 1961. Holotype: ? On living leaves of *Eriobotrya japonica*, Botanical Garden, São Paulo, Brazil, leg. A. Puttemans.
= *Pestalotiopsis longi-aristata* (Maubl.) Ribeiro de Souza - Rodriguésia 37(63): 24. 1985; a superfluous combination.

Authentic material might be present at the Herb. Museo Rio de Janeiro. The transfer to *Pestalatiopsis* Steyaert is not mentioned by Nag Raj (1993); he simply stated he had not examined relevant authentic material.

⇒ **Pestalotia paraguayensis** Maubl., in Maublanc & Rangel [as *Pestalozzia paraguariensis*] - Bol. Agric. (São Paulo) 16: 321. 1915; Maublanc - Bull. Trimestriel Soc. Mycol. France 36: 40. 1920; XXV: 599; Guba - Monograph of *Monochaetia* and *Pestalotia*: 243. 1961. Holotype: Herb. Museo Rio de Janeiro No. 552 a. On leaves of *Ilex paraguayensis*, Parana, Brazil, VII 1912.

Nag Raj (1993) did not speculate about the identity of the fungus because he could not locate any authentic material.

⇒ *Phoma anserina* El. Marchal - Champ. copr.: 11. 1891.
= **Phoma radicicola** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 90. 1905; XVIII: 250. Holotype: ? On dead roots of *Pelargonium roseum*, Philippeville, Algeria (date & leg. not specified). The fungus proposed by Maublanc matches the description of *Phoma anserina* (De Gruyter, pers. comm.).

⇒ **Phoma cytosporoides** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 70. 1904; XVIII: 255; XX: 352. Holotype: PC ex Herb. SCPV No. 5529; isotype PC ex Herb. INA. On dry twigs of *Eryngium campestre*, Pornic (Loire-Inférieure), France, 1903, leg. A. Maublanc. The original collection was divided into two parts now maintained in separate collections. Re-examination of authentic material proved that the fungus is a species of *Phomopsis* (Sacc.) Bubak. (De Gruyter, pers. comm.).

⇒ *Phoma draconis* (Berk. ex Cooke) Boerema - Versl. Meded. Plziektenk. Dienst. Wageningen 159: 24. (Jaarb. 1982) 1983; De Gruyter *et al.* - Persoonia 16: 479. 1998.

Basionym: *Phyllosticta draconis* Berk.- Welw. Crypt. Lusit.: 51. 1853 (*nom. nud.)* ex Cooke - Grevillea 19: 8. 1891.
= **Phyllosticta dracaenae** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 25: 239. 1909; XX: 384; XXII: 860; non *Phyllosticta dracaenae* Henn. - Hedwigia 48: 111. 1908 (= *Asteromella* sp.). Holotype: PC ex Herb. SCPV No. 5997. On living leaves of *Dracaenae* sp., in greenhouses close to Paris (Villepreux, Seine-et-Oise), France, X 1909, leg. A. Maublanc. Synonymy *fide* Boerema (1983).

The fungus proposed by Maublanc is a later homonym of *Phyllosticta dracaenae* Henn. However, on the basis of the original description it was found to match *Phoma draconis* (Berk. ex Cooke) Boerema (Boerema, 1983). Re-examination of the discovered authentic material studied by Maublanc confirmed the conclusion forwarded by Boerema (van der Aa, pers. comm.).

⇒ **Phoma nicotianae** Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 144. 1907; XX: 357; XXII: 883. Holotype: ?; also type material of *Mycosphaerella* (*Sphaerella*) *tabaci* Maubl. but no specimen under this binomial could be located. On twigs of *Nicotiana tabacum*, village of Razac (Dordogne), France (date & leg. not specified).

The name possibly refers to the plurivorous *Phoma exigua* Desm. var. *exigua* (De Gruyter, pers. comm.).

⇒ **Phoma umbilicaris** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 27: 473. 1911; Ann. Inst. Natl. Agron., Paris, sér. 2, 10: 104. 1911; XXV: 110. Holotype: ? In the epicarps of fruits of common peach trees, France (date & leg. not specified).

An illustration of the fungus was later provided by Griffon & Maublanc (1911).

⇒ **Phoma unedonis** Maubl. - Bull. Trimestriel Soc. Mycol. France 20: 70. 1904; XVIII: 255; XX: 360. Holotype: PC ex Herb. INA. On dead twigs of *Arbutis unedonis* (Arbousier), Pornic (Loire-Inférieure), France, 1903, leg. A. Maublanc.

Re-examination of authentic material revealed the absence of a pycnidial fungus with the characters described by Maublanc (De Gruyter, pers. comm.).

⇒ **Phyllosticta agaves** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 293. 1903; XVIII: 243; XX: 380; XXVI: 926. Holotype: PC ex Herb. SCPV No. 6373, *sub Hendersonia agaves et Phyllosticta agaves*. On leaves of *Agave* sp., Algeria (date & leg. not specified).

On the holotype collection a pycnidial fungus with the characters described by Maublanc, *l.c.,* could not be found. Several old and empty fruitbodies can be observed with small conidia as described by Maublanc, close to the fruitbodies but growing on free *Aureobasidium*-like conidiogenous cells. On one spot, immature perithecia of a pyrenomycete are present. The fungus cannot be identified from the short description only (van der Aa, pers. comm.).

⇒ **Phyllosticta owariensis** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 292-293. 1903; XVIII: 232; XX: 387. Holotype: PC ex Herb. SCPV No. 6053. On living leaves of *Landolphiae owariensis*, Dahomey (Africa), 1901, leg. G. Le Testu.

According to van der Aa (pers. comm.), the fungus can provisionally be accepted in the genus *Phyllosticta*, *aff. P. minor* Ellis & Everh. but has to be re-examined from fresh material. On the holotype collection some important details of conidiogenesis and conidial morphology cannot be studied any more. Conidia are merely in very ripe condition, many of them germinating within the pycnidial cavities, then often with 1 - 3 septae. No appressoria are seen on the slender, hyaline branching germ tubes.

⇒ *Pollacia peucedani* (Ellis & Holway) Deighton, in Deighton & Pirozynski - Mycol. Pap. 101: 41. 1965; Ellis - More Dematiaceous Hyphomycetes: 110. 1976.
Basionym: *Fusicladium peucedani* Ellis & Holway - Bull. Labs nat. Hist. St. Univ. Ia. 3 (3): 42. 1895; XI: 618; XII: 262; non *F. peucedani* Syd. - Sydowia 5: 340. 1907; XXII: 1375.
= **Asperisporium peucedani** (Ellis & Holway) Maubl. - Lavoura 16: 207. 1913; Bull. Trimestriel Soc. Mycol. France 29: 357. 1913; the synonymy is not reported in Reed & Farr (1993).

The fungus develops on species of *Angelica*, *Cicuta*, *Lomatium* and *Sphenosciadum* in the United States (Ellis, 1976; Farr *et al.*, 1989).

⇒ *Ramularia didyma* Unger - Exanth. Pfl.: 49. 1833; Braun - A Monograph of *Cercosporella*, *Ramularia* and allied genera, vol. 2: 239. 1998.
= **Ramularia aequivoga** (Ces.) Sacc. var. **bulbosa** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 70. 1906; XXII: 1312. Holotype: ? On leaves of *Ranunculus repentis*, Pornic (Loire-Inférieure), France (date ?), leg. A. Maublanc. Synonymy *fide* Braun (1998).

⇒ **Ramularia ligustrina** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 70. 1906; XXII: 1325. Holotype: PC ex Herb. SCPV No. 7582. On living leaves of *Ligustrum* sp. (*sativum* ?), close to the city of Alençon, France (date ?), leg. Lemée.
Braun (1998) recently stressed that in the absence of authentic material, the status of the fungus could not be definitely reassesssed.

The discovery of the type specimen enabled a taxonomic revision (Braun & Mouchacca, in press).

⇒ **Rhizosphaera oudemansii** Maubl., *nom. nov.* - Bull. Trimestriel Soc. Mycol. France 23: 173. 1907; Sutton - The Coelomycetes: 371. 1980; the binomial is not reported in Reed & Farr (1993).
Basionym: *Sacidium abietis* Oudem. - Contr. Fl. Myc. Pays Bas 17: 333. 1900; non *R. abietis* L.Mangin & Hariot - Bull. Trimestriel Soc. Mycol. France 23: 56. 1907; Sutton - The Coelomycetes: 371. 1980.

The fungus commonly develops on needles of *Picea*, *Abies* and *Tsuga* species in Europe and North America; details of its taxonomic history and distribution were reported by Sutton (1980).

⇒ **Rhizosphaera pini** (Corda) Maubl. - Bull. Trimestriel Soc. Mycol. France 23: 171. 1907; XXII: 917; Sutton - The Coelomycetes: 371. 1980.
Basionym: *Coniothyrium pini* Corda - Icon. Fung. 4: 38. 1840.
= *Rhizosphaera abietis* L.Mangin & Hariot - Bull. Trimestriel Soc. Mycol. France 23: 56. 1907; Sutton - The Coelomycetes: 371. 1980. Synonymy *fide* Sutton (1980).

The fungus develops on needles of *Picea* sp. and *Abies pectinata* in Europe. The taxonomic history and the distribution of the fungus were detailed by Sutton (1980).

⇒ **Septoria azaleae-indicae** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 66. 1906; XXII: 1111. Holotype: ? On living leaves of *Azalea indica*, Botanical Garden, São Paulo, Brazil, leg. A. Puttemans. Authentic material might be available at the Herb. Museo Rio de Janeiro.

⇒ **Septoria ornithogali** Pass. var. **allii** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 295. 1903; XVIII: 393. Holotype: PC ex Herb. INA. On the leaf apex of *Allium vinealis*, Pornic (Loire-Inférieure), France, IV 1904, leg. A. Maublanc.

⇒ **Septoria phaseoli** Maubl. - Bull. Trimestriel Soc. Mycol. France 22: 66-67. 1906; XXII: 1095. Holotype: ? On living leaves of *Phaseolus* sp., Botanical Garden, São Paulo, Brazil, leg. A. Puttemans. Authentic material might be available at the Herb. Museo Rio de Janeiro.

⇒ *Stagonospora agaves* (Maubl.) Mouch., comb. nov.
= **Hendersonia agaves** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 294. 1903; XVIII: 367; XIX: 855. Holotype: PC ex Herb. SCPV No. 6373, same material as for *Phyllosticta agaves* Maubl. On leaves of *Agave* sp., Algeria (date & leg. not specified). *Hendersonia* Berk. has been rejected in favour of *Stagonospora* (Sacc.) Sacc. but no extended document exists for the latter (Sutton, 1980).

⇒ **Stagonospora kentiae** Maubl. - Bull. Trimestriel Soc. Mycol. France 19: 293. 1903; XVIII: 361; XX: 879. Holotype: PC ex Herb. SCPV No. 5811; same specimen as for *Ascochyta kentiae* Maubl. On living leaves of *Kentia* sp., Algeria (date & leg. not specified). The handwriting of packet No. 5811 clearly indicates the material is also the same only for *Stagonospora kentiae* Maubl. but not again for *Pleospora kentiae* Maubl. as mentioned in the relevant publication.

⇒ *Thermomyces lanuginosus* P. Tsiklinsky - Ann. Inst. Pasteur, Paris 13: 500. 1899; Mouchacca - Crypt., Mycol. 18: 49. 1997.
= **Sepedonium lanuginosum** Griffon & Maubl. - Bull. Trimestriel Soc. Mycol. France 27: 70. 1911; XXV: 703. Holotype: ?

The original culture of *Sepedonium lanuginosum* was isolated from fresh manure and damp hay incubated at 50°C by Mr Dupont then Chief Chemist at the 'Ecole Nationale d'Agriculture de Grignon'. The living material was unfortunately not maintained. The taxonomic history of this thermophilic hyphomycete was recently reviewed (Mouchacca, 1997).

⇒ *Tiarosporella phaseolina* (Tassi) van der Aa, in von Arx - Genera of fungi sporulating in pure culture, 3rd ed. (Lehre): 208. 1981.
Basionym: *Macrophoma phaseolina* Tassi - Boll. Lab. Orto bot. Sienna 4: 9. 1901.
= *Macrophomina phaseolina* (Tassi) Goidanich - Ann. sper. Agr. Roma, N. S., 1(3): 457. 1947.

=*Tiarosporella phaseoli* (Maubl.) van der Aa - Verh. Ned. Akad. Wetens. Afd. Naturk., Amsterdamn 2, 68: 4. 1977.
Basionym: **Macrophoma phaseoli** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 90. 1905; XVIII: 269; XX: 5. Holotype: PC ex Herb. INA, labelled *pars ex typo.* On dead stems of *Phaseolus vulgaris*, Tunis, 1904 (leg. ?).
= *Macrophomina phaseoli* (Maubl.) Ashby - Trans. Brit. Mycol. Soc. 12: 145. 1927. Synonymy *fide* Holliday & Punithalingam (1970).

= *Rhizoctonia bataticola* (Taubenh.) E.J.Butler, in Briton-Jones - Bull. Minist. Agric. Egypt 49, Bot. Sect., p. 65. 1925.
Basionym: *Sclerotium bataticola* Taubenh. - Phytopathology 3: 161. 1913. Synonymy *fide* Ashby (1927).
= *Sclerotium bataticola* Taubenh. ssp. *bataticola* Reichert & Hellinger - Palestine J. Bot., Rehovot Ser. 6: 137. 1947. Synonymy *fide* Mouchacca (1999).
= *Sclerotium bataticola* Taubenh. ssp. *intermedium* Reichert & Hellinger - Palestine J. Bot., Rehovot Ser. 6: 138. 1947. Synonymy *fide* Mouchacca (1999).
= *Sclerotium bataticola* Taubenh. ssp. *sesamicola* Reichert & Hellinger - Palestine J. Bot., Rehovot Ser. 6: 138. 1947. Synonymy *fide* Mouchacca (1999).

The following synonyms are also listed by Ashby (1927): *Macrophoma corchori* Saw., *M. cajani* Syd. & Butl., *M. sesami* Saw., *Macrophomina phillippinensis* Petr., *Dothiorella cajani* Syd. & Butl. and *Rhizoctonia lamellifera* Small.

⇒ **Trichoseptoria fructigena** Maubl. - Bull. Trimestriel Soc. Mycol. France 21: 95. 1905; XVIII: 403; XX: 1018. Holotype: ? On mature fruits of *Pyrus malus* and *Cydonia vulgaris*, close to Paris, France, (date ?), leg. A. Maublanc. The fungus is now reported to induce a fruit rot in the United States (Farr *et al.*, 1989). The genus has apparently not been reassessed (Sutton, 1977; Hawksworth *et al.*, 1995).

DISCUSSION

Over one hundred species new to science were introduced by Maublanc from material originating from three continents: Europe, South America and Africa. Prime collections were made in France, mostly by Maublanc himself. These account for almost half his introductions. The second half relates almost equally to Brazil and several African countries. Brazilian specimens were collected by Maublanc during his 1912 - 1914 stay in this country. African specimens were regularly received at the Paris Plant Pathology Station for examination.

On a chronological basis, almost all the proposed names (90,00 %) were introduced in the period starting from 1903 up to the end of the first world war; a very limited fraction was described partly in the 1920's and partly in the 1930's. A very low percentage of the early proposals were co-authored with E. Griffon while most of the later ones were achieved in collaboration with L. Roger. Interestingly only a single taxon is co-authored with the Brazilian E. Rangel. It follows, therefore, that Maublanc undertook alone most of his descriptive work in the early decades of his activities. It is also evident that he made no efforts to develop the study of plant pathogenic fungi on a large scale. Furthermore, this theme of research was relegated when Maublanc developed an interest in the Homobasidiomycetes. Both trends accounts for the non elaboration of a distinguished centre of taxonomic studies of plant related fungi in his lifetime.

Maublanc's descriptions were prepared from structures developing on plant material. The novel taxa were also generally proposed on a plant-host basis. No attempts were made to prepare corresponding living cultures even when this was possible. Only four taxa were reported from living strains received for examination. These were either culture contaminants or represent thermophilic hyphomycetes. It is thus obvious that the preparation and study of living material was not a trend favoured by Maublanc.

On a taxonomic basis, over half the proposals concern deuteromycetes. The remaining brings together Ascomycetes and Basidiomycetes on a 3:1 ratio. The established list also includes one Chytridiomycete and one Oomycete. The eleven new Basidiomycetes are rusts and smuts not originating from one particular continent, although most were parasitising African plants. These specialised forms belong to common genera such as *Aecidium*, *Uredo*, *Puccinia* and *Ustilago*. The latter genus comprises the long forgotten *Ustilago andropogonis-finitimi* unrecorded since its description in 1906 (Vanky & Mouchacca, in press).

New ascomycetous taxa have original localities situated in South America. These are based on Brazilian specimens brought back by Maublanc upon his return to Europe. The new Ascomycetes belong to 24 genera and for *Leptosphaeria*, *Pleospora*, *Sphaerella*, *Calospora* and *Physalospora* more than one new species was proposed. For this taxonomic group Maublanc established three new genera. *Chaetolentomita* is no longer retained as valid. *Theissenia* was introduced to accomodate a fungus described by the German amateur mycologist Theissen and *Uropolystigma* for a Brazilian collection. Both remain unispecific and undocumented since their introduction.

New deuteromycetes disclose the reverse trend with two thirds collected solely in France. Species were proposed in 35 genera. Plant associated forms with coelomycetous affinities outnumber hyphomycetes. Best represented genera of the former group are *Gloeosporium*, *Phoma*, *Phyllosticta*, *Camarosporium* and *Coniothyrium*. Three new genera were proposed. *Lasiostroma* Griffon & Maubl. is now accepted as being identical to *Phomopsis* (Sacc.) Sacc. but its only species awaits redisposal. The unispecific *Melanobasidium* Maubl., based on material collected in Spain, remains undocumented. *Ceratopycnidium* Maubl. was proposed for a single African species. Although the fungus was not documented again a second Brazilian species was recently added (Bertoni & Cabral, 1991). Its inclusion was based on speculations about the mode of conidiogenesis in the genus extracted from the orignal drawings provided by Maublanc.

Hyphomycetous genera as *Pestalotia*, *Septoria*, *Cercospora* and *Ramularia* are well represented in terms of species numbers. Two new genera are due to Maublanc: *Asperisporium* and *Nomuraea*. Both are still in use in the taxonomic literature. The first was introduced to accomodate a species of *Cercospora* on account of the verrucose conidia; two *Scolecothricum* taxa were also transferred to the new entity. *Nomuraea* was introduced for an entomophagous fungus collected in Japan; the type species is actually well documented with the correct name being *N. rileyi* (Farlow) Samson.

It is evident from the above considerations no overall policy for the study of parasitic fungi was elaborated by Maublanc. His prime French collections were apparently made in summer resort localities. Such was succeeded by his Brazilian interruption and the transfer of his interest to basidiomycetous fungi. The several popular accounts and the two text books he wrote about members of this group confirm the shift of Maublanc's major interest from phytopathology to mycology. Finally, a fair proportion of Maublanc's novel taxa have apparently remained undocumented since their introduction. Their status thus awaits to be re-evaluated in the light of modern taxonomic concepts.

It is our hope that the publication of this annotated list of taxa proposed by Maublanc should foster the attention of taxonomists on these long forgotten binomials.

ACKNOWLEDGEMENTS

Dr H.J. Gjaerum is once again credited for his invaluable assistance in updating the taxonomic status of some rust fungi. Drs. A.Y. Rossman, H. van der Aa and W. Gams have kindly given part of their time to review portions of this note. Requests for opinions on particular taxa resulted in joint collaborative works with Drs H. van der Aa, U. Braun, H. De Gruyer and K. Vanky. Dr. A.J.L. Phillips (Universidade do Minho, Portugal) together with Dr. H. van der Aa have willingly accepted to act as pre-submission reviewers. Finally, Dr Imre Végh and Alain Leberre (Centre INRA Versailles, France) are gratefully acknowledged for their help during the search for herbarium material.

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INDEX OF NAME CHANGES

OOMYCETE *Phytophthora faberi* ⇒ *Phytophthora palmivora*
DEUTEROMYCETES
Cercospora trigonellae ⇒ *Cercospora traversiana*
Chaetophoma erysiphoïdes ⇒ *Chaetasbolisia erysiphoïdes*
Gloeosporium dendrobii ⇒ *Colletotrichum gloeosporioides*
Gloesporium hedericolum ⇒ *Colletotrichum gloeosporioides*
Gloeosporium phaji ⇒ *Colletotrichum gloeosporioides*
Gloeosporium ricini ⇒ *Colletotrichum gloeosporioides*
Gloeosporium sobraliae ⇒ *Colletotrichum gloeosporioides*
Diplodia abiegna ⇒ *Diplodia inconspicua*
Chaetodiplodia arachidis ⇒ *Lasiodiplodia theobromae*
Macrophoma ulmicola ⇒ *Macrophoma maublancii*
Diplodiella tamaricis ⇒ *Microdiplodia depazeoïdes*
Pestalotia paeoniae ⇒ *Monochaetia paeoniae*
Nomuraea prasina ⇒ *Nomuraea rileyi*
Pestalotia ceratoniae ⇒ *Pestalotiopsis ceratoniae*
Pestalotia longi-aristata ⇒ *Pestalotiopsis longi-aristata*
Phoma radicicola ⇒ *Phoma anserina*
Phoma cytosporoides ⇒ *Phomopsis* sp.
Phyllosticta dracaenae ⇒ *Phoma draconis*
Phyllosticta owariensis ⇒ *Phyllosticta* sp.
Ramularia aequivoga var. *bulbosa* ⇒ *Ramularia didyma*
Sepedonium lanuginosum ⇒ *Thermomyces lanuginosus*
Macrophoma phaseoli ⇒ *Tiarosporella phaseolina*
Hypocrea agaves ⇒ *Plowrightia agaves*
Sphaerella tabaci ⇒ *Mycosphaerella tabacii*
Sphaerella caricae ⇒ *Mycosphaerella caricae*
Chaetolentomita lignorum ⇒ *Chaetosphaeria brasiliensis*
Calonectria coralloïdes ⇒ *Melioliphila coralloïdes*
Sphaerella ilicola ⇒ *Mycosphaerella ilicicola*
Dimeriella caraçaensis ⇒ *Lasiostemma melioloides* var. *caraçaense*
BASIDIOMYCETES
Aecidium mexicanum ⇒ *Aecidium maublancii*
Uredo coffeicola ⇒ *Hemileia coffeicola*
Pleoravenelia deformans ⇒ *Ravenelia deformans*

MYCOTAXON

Volume LXXIV(2), pp. 331-335 April-June 2000

A NEW SPECIES OF INONOTUS (BASIDIOMYCOTINA) FROM YUNNAN, SOUTHERN CHINA

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ABSTRACT

A new polypore, *Inonotus indurescens* Y.C. Dai, collected from Yunnan in China, is described and illustrated. It is characterized by hard, effused-reflexed or pileate and imbricate basidiocarps, dark reddish brown to chestnut black upper surface, small pores, and the presence of both hyphoid and hymenial setae, while no setae are found in the context. Its hyphae are strongly agglutinated, and spores are yellow to rust brown, thick-walled and ellipsoid. Microscopically *I. indurescens* has similar spores and tramal hyphoid setae as those in *I. glomeratus* (Peck) Murrill, but the latter species has corky basidiocarps, yellowish brown upper surface and bigger pores, and hyphae are not agglutinated. In the context of *I. glomeratus* hyphoid setae are present. A discussion is given on the differences and similarities between the new species and those species of *Inonotus* which have hyphoid setae and thick-walled, coloured spores.

Key words: Basidiomycotina, China, *Inonotus*, *I. indurescens*, polypore

INTRODUCTION

Inonotus P. Karst is one of the well known genera in polypores, especially the species have been extensively studied in North America (Gilbertson & Ryvarden 1986) and Europe (Ryvarden & Gilbertson 1993). In Asia the species were investigated only locally. Indian species were published by Sharma (1995), and recently some new species were described from Northeast Asia (Hattori & Ryvarden 1993, Chang 1997, Chang & Chou 1998). The Chinese *Inonotus sensu lato* was summarized by Dai *et al.* (1997), and 15 species were reported in that paper. Because of the vast territory of China, extending from the boreal and temperate north, to the tropical vegetation in the south, it is evident that more species will be found especially in tropical areas.

During a study on the hymenochaetaceous fungi in China, many specimens were collected by T.X. Zhou and others from Yunnan Province in southern China, and these collections are now preserved in the herbarium of Southwest Forestry College in Kunming. In June of 1999 the senior author made a field trip to investigate wood-inhabiting fungi in Yunnan Province, and during the stay in Kunming some herbarium specimens were studied as well. Among this material, four recent collections of *Inonotus* P. Karst. were carefully studied in Helsinki, and they turned out to represent an undescribed species. In this paper the description is made.

METHODS

The measurements and drawings were made from slide preparations stained with Cotton Blue (CB). Spores were measured from sections cut from the tubes. IKI stands for Melzer's reagent and KOH for 5% potassium hydroxide; CB+ means cyanophilous. In presenting the variation in the size of the spores or other structures, 5% of the measurements were excluded from each end of the range, and are given in parentheses. In the text the following abbreviations are used: L= mean spore length (arithmetical mean of all spores, in µm), W= mean spore width (arithmetical mean of all spores, in µm), Q= quotient of the mean spore length and the mean spore width (L/W ratio), (n=x/y) x indicates measurements of spores (pores, hyphae, setae) from y specimens. The length of the setae was measured from the tip to its approximate base. Sections were studied at magnification up to x1250 by using a Leitz Diaplan microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube.

DESCRIPTION

Inonotus indurescens Y.C. Dai, *spec. nova* (Fig. 1)

Carpophorum annuum, effus-reflexum vel pileatum; facies pororum atroumbrina, pori 5–7 per mm. Systema hypharum monomiticum, hyphae septatae, setae adsunt in trama vel hymenio. Sporae ellipsoideae, flavibrunneae, crassitunicatae, IKI–, CB (+), 4.3–5.7 × 3.2–4.1 µm.

Type: **China**. Yunnan Prov., Dali, Pianma, 10.III.1999 *Zhang 36* (H, holotype, isotypes in HMAS, SWFC).

Etymology. — *indurescens* (Lat., adj.): becoming hard.

Basidiocarps annual, effused-reflexed or pileate, imbricate, bone hard and light in weight when dry, pileus usually shelf-shaped and projecting up to 2 cm, 4 cm wide and 0.5 cm thick at base. Pileal surface dark reddish brown to chestnut black, concentrically zoned, glabrous, margin acute, more or less curving down when dry. Pore surface chestnut brown to black; pores angular, 5–7(–8) per mm (n=40/2), tube mouths irregularly lacerate. Context yellowish brown to dark brown, thin (not exceeding 2 mm), bone hard. Tubes dark brown, woody hard to bone hard, up to 3 mm long.

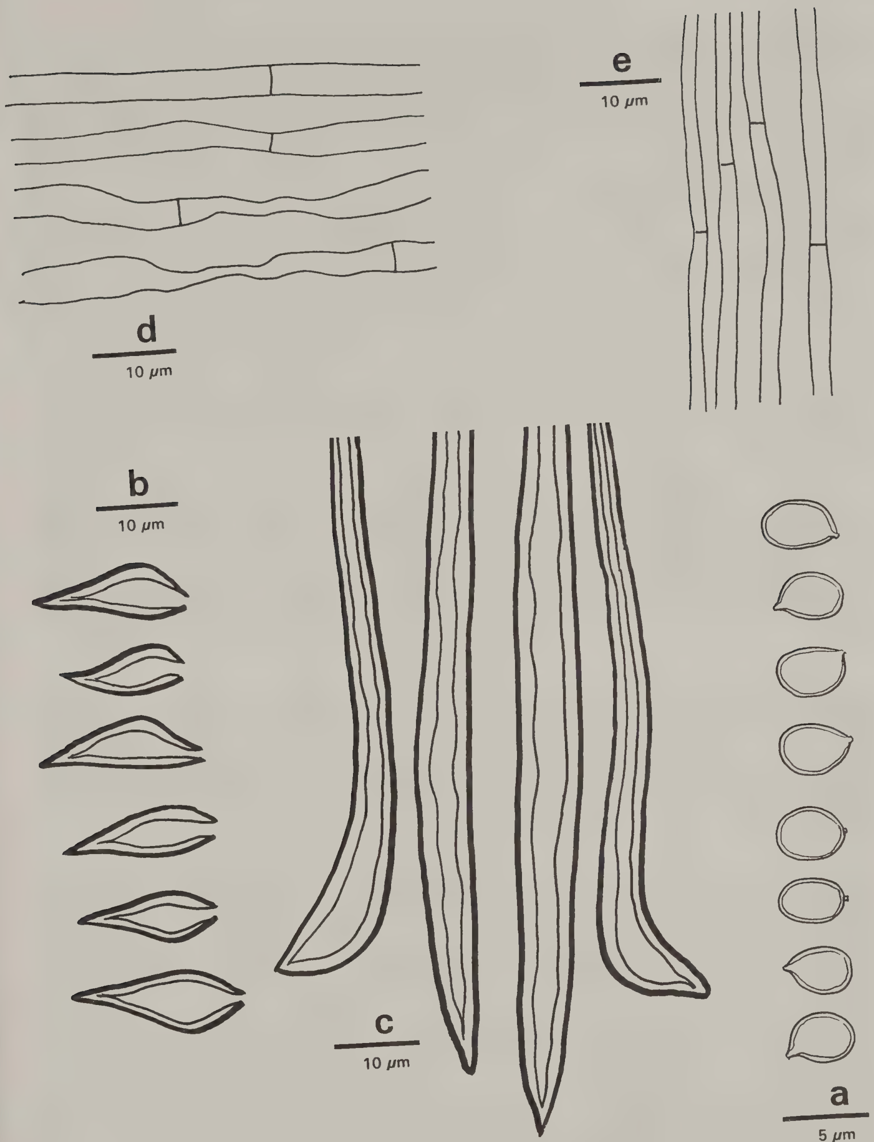
e
10 µm
d
10 µm
b
10 µm
c
10 µm
a
5 µm

Fig. 1. Microscopic structures of *Inonotus indurescens* Y.C. Dai (drawn from holotype). —a) spores, —b) hymenial setae, —c) hyphoid setae, —d) contextual hyphae, —e) tramal hyphae.

Hyphal system monomitic; all septa without clamp connections; tissues darkening but otherwise unchanged in KOH.

Context. — Generative hyphae varying from hyaline and thin-walled to yellowish and fairly thick-walled, strongly agglutinated, frequently simple septate and rarely branched, often collapsed, (3.5–)4–6 (–7) µm in diam (n=30/1). No hyphoid setae.

Tubes. — Tramal hyphae varying from pale yellowish and thin-walled to rust brown and medium thick-walled, tightly agglutinated, frequently simple septate, occasionally branched, parallel along the tubes, (2.5–)2.8–4.3(–4.5) µm in diam (n=30/1). Hyphoid setae prominent but not dominant, dark brown, distinctly thick-walled with a narrow or wide lumen, embedded in trama or curved and penetrating into hymenium, apex sharp-pointed, up to 160 µm long and 8–12 µm in diam in the widest part. Hymenial setae abundant, subulate or ventricose, dark brown, thick-walled, sharp-pointed, (18–)21–32(–36) x (5–)6–9(–10) µm (n=30/2). Subhymenium indistinct; basidia clavate, with four sterigmata and a simple basal septum, 8–10 × 4–5 µm; basidioles in shape similar to basidia, but slightly smaller.

Spores. — Basidiospores ellipsoid, yellowish to rust brown, thick-walled, smooth, IKI–, CB+ when juvenile, (4–)4.3–5.7(–6) × (3.1–)3.2–4.1(–4.4) µm, L = 4.96 µm, W = 3.69 µm, Q = 1.31–1.38 (n=61/2).

Additional specimens examined (paratypes). — **China.** Yunnan Prov., Dali, Pianma, 10.III.1999 *Gao 35* (H, SWFC), 10.III.1999 *Zhang 38 & 51* (H, SWFC).

Inonotus indurescens is characterized by hard, effused-reflexed or pileate and imbricate basidiocarps, dark reddish brown to chestnut black upper surface, and small pores. Both tramal hyphoid setae and hymenial setae are found in its structure, and the hyphae are strongly agglutinated. Like in many other species of the genus, the spores are yellow, thick-walled and ellipsoid. Differences from the closely related species are discussed below.

The following species of the genus *Inonotus* have hyphoid setae and thick-walled, coloured spores: *I. glomeratus* (Peck) Murrill, *I. iliensis* Kravtzev, *I. micantissimus* (Rick) Rajchenberg, *I. nidus-pici* Pilát, *I. ochroporus* (van der Byl) Pegler, *I. patouillardii* (Rick) Imaz., *I. pegleri* Ryvarden, *I. pruinosus* Bondartsev, *I. quercustris* M. Blackwell & Gilb., *I. rickii* (Pat.) Reid, *I. rodwayi* Reid, and *I. ulmicola* Corfixen. Among these species *I. micantissimus, I. nidus-pici, I. pegleri, I. pruinosus* and *I. ulmicola* have resupinate basidiocarps and distinctly larger spores (spore length > 6 µm and width > 4.5 µm, Rajchenberg 1987, Ryvarden & Gilbertson 1993, Ryvarden & Johansen 1980, Dai *et al.* 1997). *Inonotus iliensis* was reported from Kazakhstan (Pegler 1964). It differs from *I. indurescens* by growing as resupinate in trunk cavities; its pores are bigger (3–4 per mm), it has no hymenial setae, and its spores are relatively larger (4–7.5 x 3.7–5.6 µm). *Inonotus ochroporus, I. patouillardii, I. quercustris, I. rickii* and *I. rodwayi* have pileate basidiocarps, but these species differ from *I. indurescens* by their larger pores (2–5 per mm) and in particular, bigger spores (spore length > 6 µm and width > 4.5 µm, Ryvarden & Johansen 1980, Gilbertson & Ryvarden 1986, Pegler 1964).

Inonotus indurescens is most closely related to *I. glomeratus*: the two share similar spores and hyphoid setae in trama. The latter species is widely distributed in North America and northern India. However, *I. glomeratus* has bigger pores (3–5 per mm), and its basidiocarps are corky. Its upper surface is yellowish brown, and therefore more light-coloured than in *I. indurescens*, and its pore surface is glancing. The contextual hyphae of *I. glomeratus* are neither agglutinated nor collapsed. In addition, *I. glomeratus* has prominent hyphoid setae in its context. In contrast, *I. indurescens* has small pores (5–7 per mm), and its basidiocarps harden upon drying. The reddish brown and chestnut tones of upper surface are very dark. No silky sheen is seen in its pore surface The hyphae of the context are often collapsed, and no hyphoid setae are found in its context.

Specimen of related species examined. — *Inonotus glomeratus*. **Canada**. Quebec, Gatineau, on log of *Fagus grandifolia*, 8.IX.1993 *Ginns 9982* (H ex DAOM 221572).

Acknowledgements. We are grateful to Dr. Tuomo Niemelä (Helsinki) for improving the manuscript, and to Prof. Teuvo Ahti (Helsinki) who helped in preparing the Latin description. Financial support to Yu-Cheng Dai from the Academy of Finland (Project No. 44173, 1998–2000) is gratefully acknowledged.

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MYCOTAXON
Volume LXXIV(2), pp. 337-342 April-June 2000

A NEW SPECIES OF SPOROCARPIC GLOMALES FROM SOUTH AFRICA

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Glomus avelingiae sp. nov. RC Sinclair is described and illustrated from collections made from the rhizosphere of an indigenous fruit-bearing tree, *Vangueria infausta* Burch. subsp. *infausta* near Cullinan, South Africa. Sporocarp morphology is presented as an important diagnostic feature.

Key words: Glomales, *Glomus*, sporocarp, arbuscular mycorrhizal fungi, South Africa.

Introduction

The order, Glomales was created to include all soil-borne fungi which form arbuscules in obligate mutualistic association with terrestrial plants (Morton and Benny, 1990). As an asexually reproducing species designated by morphology (form- or morph-species), a physiological prerequisite can create dilemma's, however sufficient morphological and habitat characteristics facilitate recognition of fungi from this order. Nonetheless, records of collections of arbuscular mycorrhizal (AM) fungi from South Africa are few. A collection of an *Endogone* Link:Fr species (Hattingh, 1972) was later identified as *Acaulospora laevis* Gerdemann & Trappe (Coetzee, 1982). Coetzee named a second collection of *A. laevis* from a different locality "with reservations" (pers. comm.) which is now deposited in the Pretoria Mycological Herbarium (PREM 45880). AM fungi have been collected from sand dunes in one of South Africa's neighboring countries, Namibia. These specimens have been sent to C. Walker in the UK for positive identification (K. Jacobson, pers. comm.). Some additional samples from Namibia are being pot cultured at the International Collection of Arbuscular and Vesicular-Arbuscular Mycorrhizal Fungi (INVAM) in West Virginia (Morton *et al.*, 1993) for study. Hoffman and Mitchell (1986) recognized four different "types" of AM fungi associated with *Acacia saligna* (Labill.) Wendl., an invader plant of the sensitive fynbos biome of the south-western Cape of South Africa but these fungi were not identified to species level. The present authors contributed to a recent report where some common AM fungi were identified (Gaur *et al.*, 1999) however, no taxonomic work, particularly from regionally important biomes in southern Africa, has been accomplished thus far.

Investigations begun at the University of Pretoria, have concentrated on the isolation and identification of indigenous species of AM fungi from the region. In this process, a new sporocarpic species in the sub-order Glomineae, family Glomaceae has been discovered. Spore size, color and in particular, wall layer characteristics are used to distinguish this taxon in the Glomaceae. Ontogenetic sequence in wall layer development has been investigated in several taxa in the genus *Glomus* (Stürmer and Morton, 1997), increasing the evidence of polyphyly in this apparently heterogenous taxon. Spore age differences within the sporocarp in our collection has enabled investigation of spore ontogeny. Sporocarp morphology, known only in a few of the taxa in this family, is described here with an implication to the taxonomic usefulness of this characteristic.

Materials and Methods

Glomus avelingiae is described herein from a fresh, field-collected specimen. Microscopic investigations of sporocarp morphology and spore wall structure were done on specimens mounted in lactophenol, polyvinyl-lactic acid-glycerin and polyvinyl-lactic acid-glygerin with 1:1 (v/v) Meltzer's reagent. Thin sections (1.2 and 2 μm) were made of the sporocarp and studied with the transmission electron microscope. Light microscope examinations of the sectioned specimens were made with the aid of toluidine blue o staining. Color was determined with the use of the INVAM color chart (obtained from INVAM: 401 Brooks Hall, PO Box 6057, West Virginia University, Morganstown, WV, 26506-6057).

Taxonomic Part

Glomus avelingiae RC Sinclair, *sp. nov.* (Fig. 2 A-H)

[Etymology: this species is named in honour of its collector, Dr. Theresa Aveling.]

Sporocarpia epigaea, luteobrunnea vel pallide brunnea, iregulariter elliptica et modice convoluta, 1.0-1.2 X 1.8-2.2 mm, interdum materiam alienam aliquantum retinentia. Peridium nullum. Pagina sporocarpii crenulata ob chlamydosporas expositas. Chlamydosporae in sporocarpio contigue et fortuito dispositae, cum hyphis 8-10 μm crassis. Chlamydosporae maturae et immaturae valde approximatae repertae. Chlamydosporae maturae globosae vel subglobosae 64-80 μm, cum uno pariete quadristrato: strato intimo flexili, minus quam 0.5 μm crasso; strato medio laminato, pallide luteobrunneo, 1.6-2.4 μm crasso; duobus extimis subhyalinis, saepe ut videtur uno 0.6-0.8 μm crasso; immaturae bistratae. Hypha subtendens 8-10 μm lata, cylindrica, ad 5-7 μm angustata ad basin chlamydosporae, cum septo usque ad 1.5 μm crasso. Hoc septum interdum ad 4 μm infra basin sporae extensum, e strato medio laminato compositum. Chlamydosporae stratum medium deorsum extensum per 6-10 μm in hypha subtendenti.

Epigaeus sub *Vangueria infausta* subsp. *infausta* Burch., prope viae latus, circa 10 km ad septentrio-occidentem e pago Cullinan dicto, Gauteng Provincia, South Africa, 10 November 1994, T.A.S. Aveling, **PREM** 55918, holotypus.

Sporocarp epigeous, yellowish brown to pale brown, irregularly elliptical and moderately convoluted, 1.0-1.2 x 1.8-2.2 mm, sometimes retaining small amounts of foreign material. **Peridium** absent. **Sporocarp surface** crenulate due to exposed chlamydospores. Sporocarp hyphae 8-10 μm wide, bundled together, intertwined, coursing through the spore mass. Spores formed as determinate swellings of tips of sporogenous hyphae. **Chlamydospores** arranged in sporocarp adjacent to each other and random throughout. Mature and immature chlamydospores occurring in close proximity to each other. Mature chlamydospores globose to subglobose, 64-80 μm in diameter with one wall of four layers: innermost layer flexible, less than 0.5 μm thick; middle layer laminate, pale yellowish brown, 1.6-2.4 μm thick; outer bi-layer, subhyaline, 0.6-0.8 μm thick, often appearing as one layer. Juvenile chlamydospores have 2 layers. **Subtending hypha** 8-10 μm wide, 2-layered, cylindrical, narrow at the base of the chlamydospore to 5-7 μm, having a septum up to 1.5 μm thick. Septum in the subtending hypha composed of the middle laminate layer, sometimes extending 4 μm below the point of attachment at the spore base. Middle layer of the spore extending down the subtending hypha 6-10 μm.

In the rhizosphere near the soil surface beneath *Vangueria infausta* Burch. subsp. *infausta*; South Africa.

Collections examined: from the rhizosphere near the soil surface beneath *Vangueria infausta* Burch. subsp. *infausta*, near roadside approximately 10 km northwest of Cullinan, Gauteng Province, 10 November, 1994, T.A.S. Aveling, **PREM** 55918, holotype. An isotype has been sent to C.M.I., Kew for deposition.

Sporocarp color is 0-40-100-0 and chlamydospore color is 0-20-60-0 using the INVAM colour chart. There was no reaction by any of the spore wall layers or hyphae in the presence of Meltzer's reagent. The most commonly occurring mature spore size is 72 μm. A bar graph of the mature spore size range is provided (Fig. 1). A graphic presentation is made of some of the salient characteristics in this species (Fig. 2).

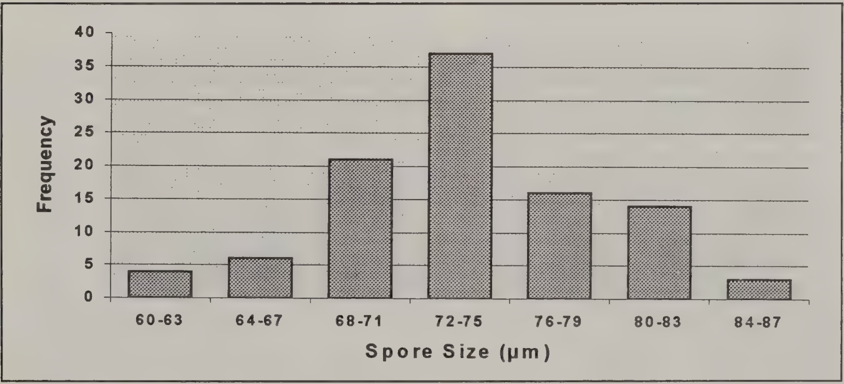

Fig. 1. Spore size range from a random selection of 100 mature spores.

Discussion

The most juvenile stage in *G. avelingiae* presented similarities to the second group described by Stürmer and Morton (1997) where the spore and hyphal wall are comprised of two layers i.e. a mucilaginous layer and a semiflexible hyaline layer. Differentiation proceeded by the appearance of a thin laminate layer and concurrent differentiation of two colorless laminae on the exterior and a thin flexible inner layer. Transmission electron microscopy provided less obvious differentiation of the layers in this species which further supports the conclusions of other authors (Maia *et al., 1993;* Morton, 1996) that the spore wall in the Glomales is a single structure. The spore wall is differentiated into regions of unequal density and composition that are often more easily distinguished with a light microscope.

The main characteristics distinguishing *G. avelingiae* from other members in the genus *Glomus* is the spore size and wall structure and the true septum in the subtending hyphae formed from part of the laminated layer of the spore wall. The only other species with spores described having similar size range and wall layering is *Glomus fragile* (Berkeley & Broome) Trappe & Gerdemann. According to the description by Gerdemann and Trappe (1974) this species also has a septum at the hyphal attachment and is similar in spore shape, size, color and the configuration of the two relatively thin wall layers. However, no double layering of the outer layer is mentioned, nor is the thin inner flexible layer. Sporocarp formation has not been described in *G. fragile*. Material of *G. fragile*, known only from the type locality, was unavailable for examination. *G. avelingiae* is known only from the type locality.

The formation of the sporocarp in *G. avelingiae*, with bundled hyphae intertwining the spore mass, is distinct in its apparent randomness. This, as opposed to the orderly structure seen in other sporocarpic Glomales (Wu, 1993) from similar habitats suggests a genetic governance, contrary to the implication made by Morton (1988) that it is environmentally determined. We feel that sporocarp developmental morphology has taxonomic significance as does the ontogenetic sequence of chlamydospore morphology.

Asexuality in the Glomales is a cardinal genetic feature, as it is in the asexually reproducing Mitosporic fungi (formerly Deuteromycetes). Genetic isolation as a result of the loss of sexual recombination should be a factor in a low diversity which appears to be the case in the Glomales with so few taxa recognized. This is apparently not

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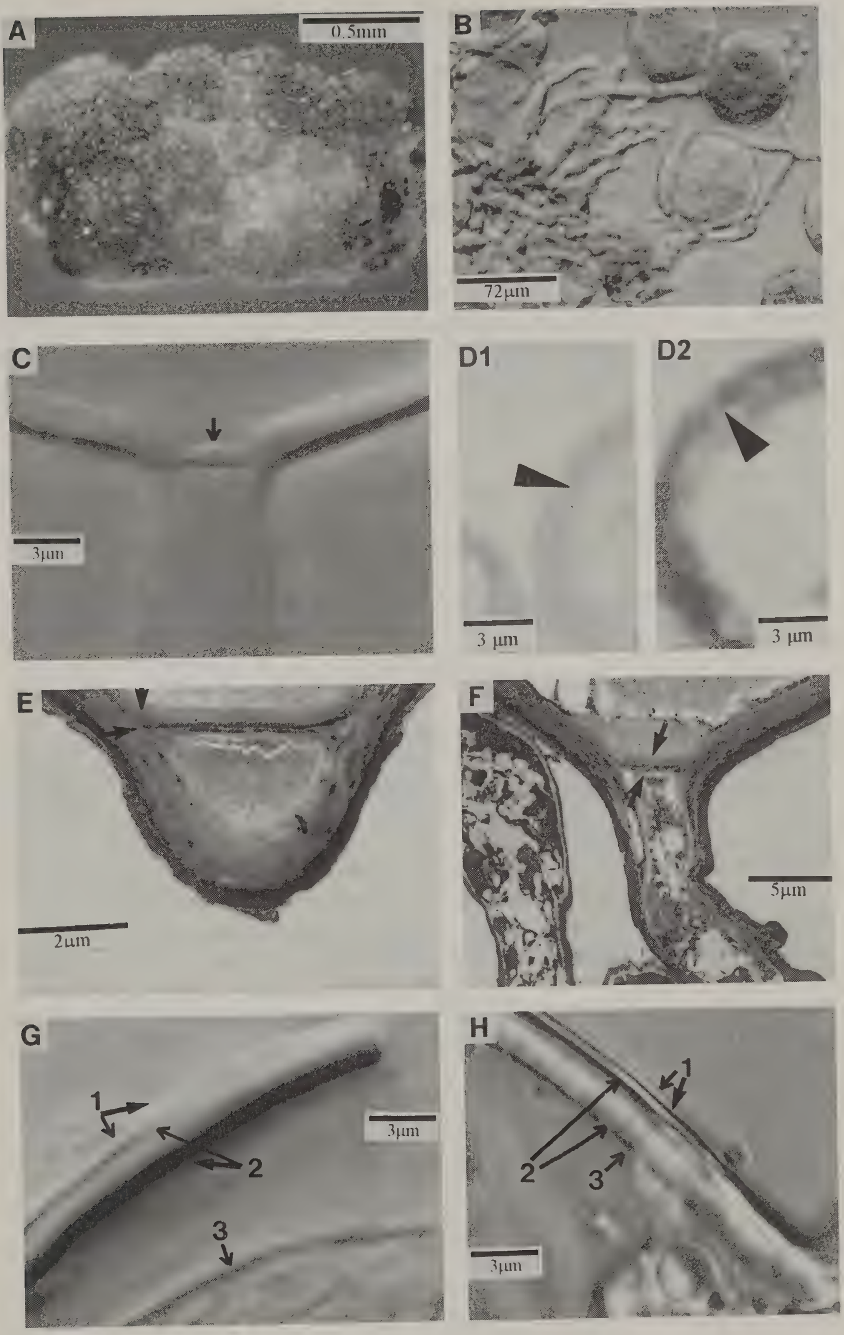
Fig. 2 A-H. *Glomus avelingiae* A. Sporocarp; B. Chlamydospores surrounded by interwoven hyphae; C. Septum at subtending hyphal attachment; D1 & D2 . Juvenile stage of spore development indicating double layer; E & F. Transmission electron micrograph demonstrating contribution of laminate layer to subtending hyphal septum; F. Transmission electron micrograph depicting differentiated layers in spore wall and septum as oppossed to the less differentiated double layer in the distal portion of the subtending hyphal wall; G &H. Oil immersion light micrograph demonstrating multiple layers of the spore wall.


A
0.5mm
B
72μm
C
3μm
D1
3 μm
D2
3 μm
E
2μm
F
5μm
G
1
2
3
3μm
H
1
2
3
3μm

the case in the Mitosporic fungi which have perhaps the largest diversity of all the groups of fungi. In the Glomales the subterranean habit enforcing a low dispersal potential and the obligate dependence on a plant may have served to physically restrict gene flow moreso than in the Mitosporic fungi. However as evidence mounts, it is likely that even the most subtle morphological difference will define distinct lineages in this group of fungi.

Acknowledgements

Financial support from the National Research Foundation is acknowledged. We thank Dr. H.F. Glen of the National Botanical Herbarium of South Africa, N.B.I., Pretoria, for reviewing the latin diagnoses. We thank Prof Mike J Wingfield, Director of the Forestry and Agricultural Biotechnology Institute, University of Pretoria for reviewing the manuscript. We also thank Alan Hall and CF vd Merwe of the University of Pretoria Unit for Electron Microscopy for help with the transmission electron micrographs.

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MYCOTAXON
Volume LXXIV(2), pp. 343-356 April-June 2000

NEW TAXA OF USTILAGINOMYCETES

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ABSTRACT

Proposed new taxa: Cintractiaceae K. Vánky (type *Cintractia*), *Restiosporium* K. Vánky (type *R. meneyae* K. Vánky, sp. nov., on *Lyginia barbata*), *Anthracoidea wakatipu* K. Vánky (type on *Carex wakatipu*). Three new combinations into the genus *Restiosporium*, and twenty-four into the genus *Moreaua* are proposed. *Tolyposporium* is considered a monospecific genus restricted to host plants in the Juncaceae. *Restiosporium* is restricted to host plants in the Restionaceae, and *Moreaua* to host plants in the Cyperaceae.

INTRODUCTION

Intensive study of smut fungi during the last three decades resulted not only in the description of new species and genera, but also in the elaboration of a new classificatory system (Bauer et al., 1997, Begerow et al., 1997, Vánky, 1999b) based on ultrastructural, molecular and classical morphological characters. In this new, but still not definite system, the c. 1450 known "classical" smut fungi (those possessing teliospores) are classified into 2 classes, 8 orders, 17 families, and 71 genera. The family Ustilaginaceae L.-R. & C. Tul., emend. R. Bauer & Oberw., possessing poreless septa, intracellular hyphae coated by an electron-opaque matrix, and phragmobasidia, represents a heterogeneous assemblage of 22 genera. Recently, based on the production of typical two-celled basidia, the genus *Anthracoidea* was separated from the Ustilaginaceae into the Anthracoideaceae Denchev (1997:413).

MATERIALS AND METHODS

For materials and methods see Vánky, 1994:8-9.

RESULTS AND DISCUSSION

Germination of several *Cintractia* species (*C. amazonica* H. & P. Sydow, *C. axicola* (Berk.) Cornu (including *C. peribebuyensis* (Speg.) Sawada), *C. limitata* Clinton, *C. mitchellii* K. Vánky, *C. taubertiana* (Henn.) Clinton) shows an unusual pattern (comp. Nene & Bhelwa, 1976, Ingold, 1995, 1999, Piepenbring, 1996, Piepenbring et al., 1999, Vánky, 1997a:164, Fig. 12). Namely, the cells of the four-celled basidium conjugate pairwise, and from each conjugated pair a relatively large blastoconidium is produced. This is probably dikaryotic and is borne on a well-defined sterigma. In connection with this unusual and striking pattern of teliospore germination in species of *Cintractia*, Ingold (1999:1072) wrote: "it is clear that the course of teliospore germination departs considerably from the standard *Ustilago* type". Based on these observations, and on a combination of other characters of *Cintractia* Cornu (type *C. axicola*), I am proposing a new family:

Cintractiaceae K. Vánky, **fam. nov.**

Membrum ordinis Ustilaginales G. P. Clinton, emend. R. Bauer & Oberw., subcl. Ustilaginomycetidae Jülich, emend. R. Bauer & Oberw., cl. Ustilaginomycetes R. Bauer, Oberw. & K. Vánky. Sori in superficie plantarum nutriciarum familiae Cyperaceae in statu juvenili plerumque mambrana fungali cooperti. Massa sporarum nigra, e sporis singulis, pigmentatis (rubro-brunneis) composita. Germinatio sporarum phragmobasidiis 4-cellularibus. Cellulae binae compatibiles basidii unitae blastoconidium unum magnum, verisimiliter dicaryoricum in sterigmate producentes; multo rarius etiam basidiosporas producentes. Interactio plantae et parasitae eius per hyphas intracellulares, matrice electronopaca circumdatas, septis evolutis sine poris. Genus typicum: *Cintractia* Cornu, Ann. Sci. Nat. Bot., Sér. 6, 15:279, 1883.

Member of the ord. Ustilaginales G. P. Clinton, emend. R. Bauer & Oberw., subcl. Ustilaginomycetidae Jülich, emend. R. Bauer & Oberw., cl. Ustilaginomycetes R. Bauer, Oberw. & K. Vánky. Sori on the surface of host plants belonging to the Cyperaceae family, when young usually covered by a fungal membrane. Spore mass black, composed of single, pigmented (reddish-brown) spores. Spore germination results in 4-celled phragmobasidia. Compatible basidial cells fuse two by two giving rise to a large, probably dikaryotic blastoconidium on a sterigma; more rarely also basidiospores are produced. Host-parasite interaction by intracellular hyphae coated by an electron-opaque matrix, mature septa are poreless. Type genus: *Cintractia* Cornu.

Tolyposporium Woronin ex Schröter (type: *T. junci*) also belongs to the Ustilaginaceae. In its present circumscription, *Tolyposporium* is still heterogenous (comp. Vánky, 1987:116), comprising spore-ball-forming smut fungi on host plants belonging to the families of Juncaceae, Cyperaceae and Restionaceae. Studying these smut fungi, I wrote (Vánky, 1998:521): "There is, however, some evidence that '*Tolyposporium*' species on these three host families are generically different, each genus being restricted to host plants of the same family". It is now appropriate to realize this idea, to describe *Restiosporium* for the smut fungi on Restionaceae, and place the "*Tolyposporium*" species on Cyperaceae into the genus *Moreaua* T. N. Liou & H. C. Cheng, available for them. *Tolyposporium* is considered to be a monospecific genus on host plants belonging to the Juncaceae.

In ***Tolyposporium junci*** (Schröter) Woronin ex Schröter, in Cohn (Aug. 27) 1887:276 (type on *Juncus bufonius* L.) the sori are external, naked, tumour-like, black, agglutinated, on the surface of the flowers, or part of them, around the axis of the spikelets, less often at the base of the floral stems and basal leaves. *Spore balls* are persistent, variable in shape and size, globose, subglobose, elongate or irregular, 16–50(–80) µm long, opaque, dark reddish-brown to blackish-brown, composed of 3–40 or more spores. The spore balls are formed in the central (basal) part of the sorus. From the mass of more or less radially arranged sporogenous hyphae growing out of the host tissue, thin-walled, colourless groups of irregular, often elongated spore initials appear. These increase in size, become rounded, and the dark outer wall appears, "cementing" the young spores together into spore balls. Older spore balls are successively pushed toward the periphery by newly-formed spore balls, but they remain in contact with the host through the elongated sporogenous hyphae, which disappear at maturity of the spores. The mature spore balls successively reach the surface of the naked sorus and become dispersed (comp. Vánky, 1994:276, Figs. A, B. C). *Spores* are subglobose to more or less angular, often subcuneiform and irregular, 6–13 x 8–17(–20) µm, dark yellowish-brown to blackish-brown, smooth on the contact surface and with irregular warts or tubercles on the free, slightly convex surface. The wall is unequally thickened (0.5–4 µm), two-layered. *Spore germination* (after a resting period, in water), usually results in four-celled basidia with basidiospores borne at the septa (Woronin, 1881(1882):575, Brefeld, 1895:150, Pl. IX, figs. 13–24). On Juncaceae: *Juncus bufonius* L. and *J. capitatus* Weigel, Europe, North America.

Typical for *Tolyposporium* are the sori on the surface of different organs of the host plant, the formation of the spore balls from a basal, hyaline mass of sporogenous hyphae, the permanent spore balls held together by a thick matrix, appearing electron-opaque in TEM, the coarsely ornamented free surface of the spores, and the spore germination.

The genus ***Heterotolyposporium*** K. Vánky, with two known species (type: *H. lepidospermae* K. Vánky), differs from the genus *Tolyposporium* in having concommitantly two different kinds of spores, mixed in the sori (Vánky, 1997b).

The smut fungi of Restionaceae.

On members of the Restionaceae family four smut fungi have been published: **1.** *Thecaphora leptocarpi* Berk. **2.** *Tolyposporium lepidoboli* McAlp., **3.** *T. restionum* (Nees) Websdane et al., and **4.** *Websdanea lyginiae* (Websdane, Shivasithamparam, Dixon & Pate) K. Vánky (based on *Ustilago lyginiae*).

All known smut fungi on Restionaceae form spore balls composed of pigmented spores only. For this reason they were placed into the genus *Thecaphora* Fingerh., or into the genus *Tolyposporium* Woronin ex Schröter. These two genera differ morphologically (comp. Vánky, 1987, 1998) and also in their molecular characters (comp. Begerow, et al., 1997). Furthermore, species of *Thecaphora* parasitise dicotyledonous host plants, those of *Tolyposporium* monocotyledonous ones. In the new classificatory system, *Thecaphora* belongs to the Glomosporiaceae Cif. emend. Begerow, R. Bauer & Oberw., *Tolyposporium* to the Ustilaginaceae L.-R. & C. Tul., emend. R. Bauer & Oberw.

The smut fungi of Restionaceae, except for *Websdanea lyginiae*, form their sori in the capsules, replacing the seeds by a black, granular powdery mass of spore balls. These are produced within a hyaline mass of sporogenous hyphae. The sori in *T. junci* and "*Tolyposporium*" species on Cyperaceae are external, on the surface of the host tissues. The morphology of the spore balls, spores and spore walls is also different in these groups of smut fungi (comp. Websdane, 1995:27, Fig. 2.1, Piepenbring et al., 1998, Figs. 62, 64). The spore balls in *T. junci* and "*Tolyposporium*" species on Cyperaceae are rather permanent and it is often difficult or impossible to separate them into spores. The spores are often wedge-shaped, with thick wall on the free surface. The spore balls of the smut fungi of Restionaceae are rather loose, easily separating, the spores are rounded or polyhedrally irregular, the spore wall is uniformly thick. In the only successful spore germination of a smut of Restionaceae (excepting *Websdanea*), the resulting basidia were four-celled. Compatible basidial cells fused pairwise by long copulation bridges. Such fusion of basidial cells is typical for *Cintractia* species, but was not observed in *T. junci* and "*Tolyposporium*" species on Cyperaceae. The few molecular data published (Piepenbring et al., 1999) show that *T. junci* and "*Tolyposporium*" *rhynchosporae-cephalotis* K. & T. Vánky are not related.

Based on the differences in sorus structure, development and morphology of spore balls and spores, and in spore germination of *Tolyposporium junci*, smut fungi of Restionaceae and species of "*Tolyposporium*" of Cyperaceae, I am proposing the recognition of three genera, each genus restricted to host plants in the same family. Actually, the smut fungi of Restionaceae cannot be included in any earlier known genus (comp. Vánky, 1987). Molecular data also support the splitting of *Tolyposporium* sensu lato. The following new taxa and recombinations are proposed:

Restiosporium K. Vánky, **gen. nov.**

Sori semina in fructibus plantarum familiae Restionaceae massa glomerulorum sporarum nigra, granuloso-pulverea, in massa hypharum sporogenearum differentiata substituentes. *Glomeruli sporarum* satis laxi, e sporis tantum compositi. Peridium, columella et cellulae steriles absentes. *Sporae* pigmentiferae. *Germinatio sporarum* (si nota) phragmobasidiis 4-cellularibus, quorum cellulae basidiales binatim fusae. Interactio inter matricem et parasitam per hyphas parasiticae intracellulares indumento electronopaco circumdatae. Septa matura sine poris. Plantae masculinae affectae gynoeceum simul cum soris producentes. Typus generis: *R. meneyae*.

Sori in the fruits of plants in the Restionaceae family, replacing the seeds by a black, granular powdery mass of spore balls differentiating within a mass of sporogenous hyphae. Spore balls rather loose, composed of spores only. Peridium, columella and sterile cells are lacking. Spores pigmented. Spore germination (where it is known) results in four-celled phragmobasidia in which basidial cells fuse pairwise. Parasitic hyphae intracellular coated by an electron-opaque matrix. Mature septa are poreless. Attacked male plants develop gynoecia with sori. Typus generis:

Restiosporium meneyae K. Vánky, sp. nov.

Typus in matrice *Lyginia barbata* (Labill.) R. Br., Australia, Western Australia, cca. 200 km N urbe Perth, Dandaragan Distr., Brand Hwy inter Cataby Roadhouse et Badgingarra, 30°33'27" S, 115°28'20" E, alt. cca. 200 m, 30.I.1996, leg. K. Websdane, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 17938!), isotypi in PERTH et in Vánky, Ust. exs. No. 1075. Paratypi: idem, 25.II.1992, leg. K. Meney (UWA, HUV 17161!); WA, 19 km SE urbe Perth, 32°05'13" S, 115°58'40" E, XI.1992, leg. K. Meney (UWA, HUV 17162!); WA, Albany Distr., 15 km S urbe Albany, Torndirrup National Park, 35°06'30" S, 117°57' E, alt. 150 m, 11.II.1996, leg. C. et K. Vánky (PERTH, HUV 17940!).

Sori inconspicui, in capsulis, eas massa glomerulorum sporarum nigra, granuloso-pulverea implentes. Plantae infectae masculinae capsulas cum sporis producentes. Infectio systemica, flores omnes eiusdem plantae infectae. Capsulae infectae minores et plures quam illae plantarum salvarum feminearum. *Glomeruli sporarum* forma et magnitudine varii, ovoidei, elongati vel irregulares, 40–70(–80) x 50–100(–120) µm, atro-olivaceobrunnei, e multitudine magna (pluries decem usque pluries centum) sporarum faciliter sejunctarum compositi. Glomeruli sporarum ex cavitis hypharum sporogenearum in massa hyalina hypharum concentratis evoluti. *Sporae* forma et magnitudine variae, subglobosae, ovoideae, elongatae, plerumque subpolyhedriciter vel polyhedriciter irregulares, sub microscopio luce transeunte (LM) visu superficiali acies acutos sicut lineas in superficie sporarum ostendentes, sporae 7–10 x 9–14 µm, olivaceo-brunneae; pariete tenui, aequali (0,5–1 µm crasso), conspicue levi.

Sori (Fig. 1) inconspicuous, in the capsules filled with black, granular-powdery mass of spore balls. Infected male plants develop capsules with spores. Infection systemic, all flowers of a plant being infected. Infected capsules smaller and in greater number per culm than those of healthy female plants. *Spore balls* (Figs. 2, 3) variable in shape and size, ovoid, elongated or irregular, 40–70(–80) x 50–100(–120) µm, dark olivaceous-brown, composed of a great number (tens to hundreds) of easily separating spores. Spore balls develop (Fig. 4) from concentrated groups of sporogenous hyphae within a hyaline mass of hyphae. *Spores* (Figs. 2, 3) variable in shape and size, subglobose, ovoid, elongated, usually subpolyhedrally or polyhedrally irregular, in LM often with acute edges showing as lines on the spore surface when the spores are seen in surface view, spores 7–10 x 9–14 µm, olivaceous-brown; wall thin, even (0.5–1 µm thick), apparently smooth.

Etymology: *Restio-* from the host family Restionaceae, *-sporium* is the ending of many spore-ball-forming smut genera. *R. meneyae* is named after the excellent specialist of Restionaceae, Dr. Kathy Meney (Perth, Australia), who also collected many smut fungi, including, for the first time, this species.

1

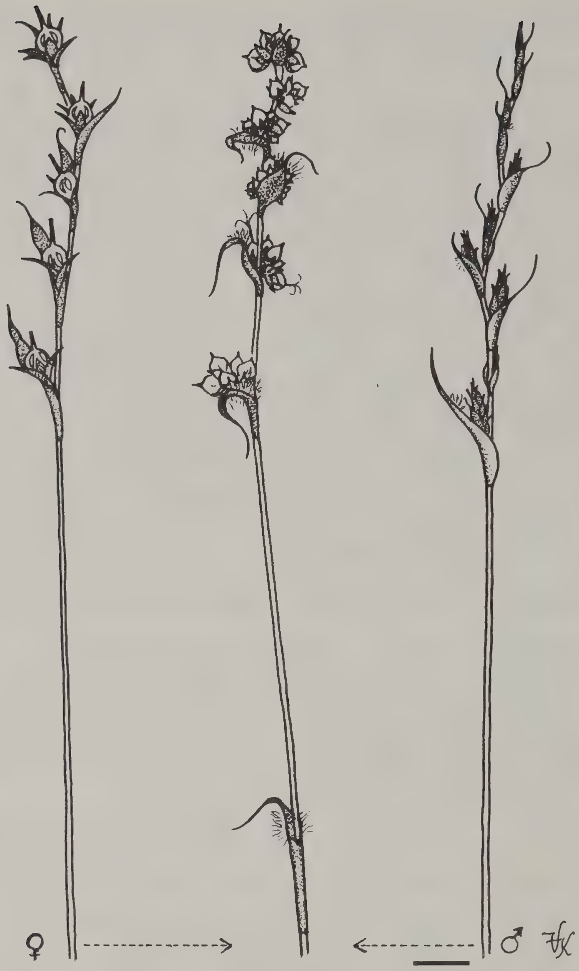


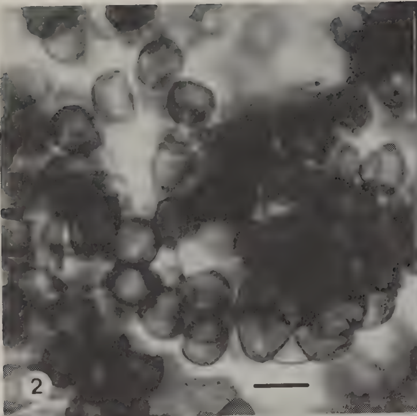
Fig. 1. Sori of *Restiosporium meneyae* K. Vánky in the capsules of *Lyginia barbata* (Labill.) R. Br. (type). To the left a healthy female plant, to the right a healthy male plant, in the middle an infected female or male plant. Bar = 1 cm.

Figs. 2, 3. Spores of *Restiosporium meneyae* K. Vánky on *Lyginia barbata* (Labill.) R. Br. in LM and in SEM (type). Bars = 10 µm.

Fig. 4. Spore ball formation of *Restiosporium meneyae* (type). Bar = 10 µm.

Fig. 5. Spore ball formation of *Moreaua aterrima* (L.-R. & C. Tul.) K. Vánky on *Carex caryophyllea* Latourr. (HUV 2044). h = host tissue. Bar = 25 µm.

Figs. 6, 7. Spores of *Anthracoidea wakatipu* K. Vánky on *Carex wakatipu* Pertie, in LM and in SEM (type). Bars = 10 µm.



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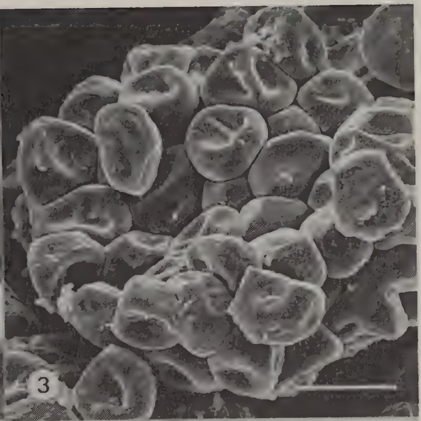

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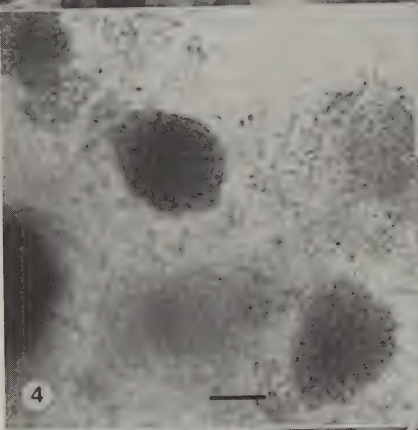

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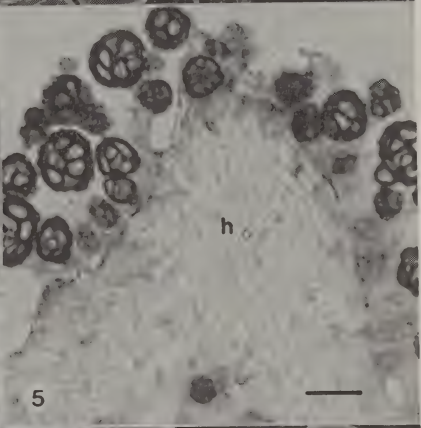

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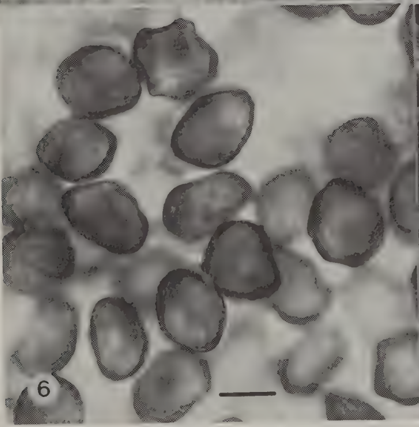

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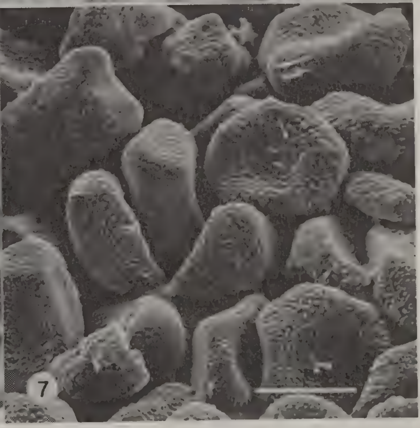

7

The following three species also belong to the genus *Restiosporium*:

Restiosporium lepidoboli (McAlpine) K. Vánky, **comb. nov.**

Basionym: *Tolyposporium lepidoboli* McAlpine, Proc. Linn. Soc. New South Wales 29:127, 1904. – Type on *Lepidobolus drapetocoleus* F. Muell., Australia.

Restiosporium leptocarpi (Berkeley) K. Vánky, **comb. nov.**

Basionym: *Thecaphora leptocarpi* Berkeley, J. Linnean Soc. Bot 18:388, 1881. – Type on *Leptocarpus tenax* R. Br., Australia.

Restiosporium restionum (Nees) K. Vánky, **comb. nov.**

Basionym: *Uredo restionum* Nees, in Lehmann, Pl. Preiss. Enum. 2:59, 1846. – *Tolyposporium restionum* (Nees) Websdane, Sivasithamparam, Dixon & Meney, 1994:473. – Type on *Restio nitens* Nees (= *Alexgeorgea nitens* (Nees) L. Johnson & B. Briggs), Australia.

8

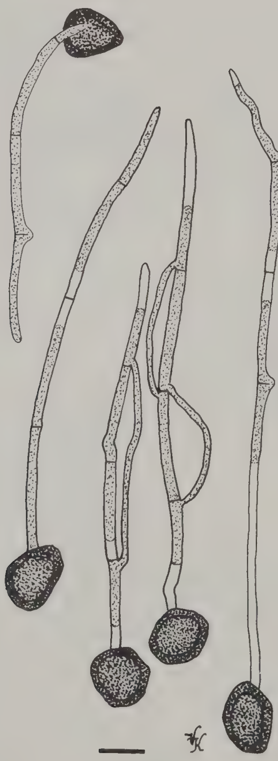

Fig. 8. Germinating spores of *Restiosporium* sp. on *Lepidobolus chaetocephalus* F. Mueller (on WA, at room temp., in 3 weeks; spores previously treated with Amisept; Dr. R. Bauer; HUV 17979) Bar = 10 µm

Tolyposporium being considered a monospecific genus, restricted to the Juncaceae, the spore ball forming smut fungi on Cyperaceae belong to another genus. For these smuts the genus *Moreaua* is available.

Moreaua T. N. Liou & H. C. Cheng, 1949:209, emend. K. Vánky.
Sori naked on the surface of inner floral organs of Cyperaceae, composed of black, granular-powdery mass of spore balls. Columella, peridium and sterile cells are lacking. *Spore balls* composed of rather firmly united spores. *Spores* usually wedge-shaped, pigmented (reddish- or blackish-brown), wall thick on the free surface. *Spore germination* results in four-celled phragmobasidia with sessile basidiospores. *Host-parasite interaction* by intracellular hyphae coated by an electron-opaque matrix. Mature *septa* are poreless. Typus generis: *Moreaua kungii* T. N. Liou & H. C. Cheng (= *Thecaphora aterrima*, = *Moreaua aterrima*).

Moreaua aterrima (L.-R. & C. Tulasne) K. Vánky, **comb. nov.**
Basionym: *Thecaphora aterrima* L.-R. & C. Tulasne, Ann. Sci. Nat. Bot., Sér. 3, 7:110, 1847. – *Tolyposporium aterrimum* (L.-R. & C. Tulasne) Dietel, in Engler & Prantl, 1897:14. – Lectotype (designated by Liro, 1938:310) on *Carex praecox* Jacq. [= *C. caryophyllea* Latourr.], France, Vienne Dépt., Pictavia [= Poitiers], coll. S. Delacroix.

Sorosporium atrum Peck, 1880:35. – Type on *Carex pennsylvanica* Lam., USA, Colorado, 6000 ft, VI, M. E. Jones.

Sorosporium flahaultii Boyer & Jaczewski, 1894:CCLXXVII. – Type on *Carex olbiensis* Jordan, France, Hérault Dépt., "Bois de Montarnaud" near Montpellier, Ch. Flahault.

Sorosporium caricis Ferraris, 1902:191. – Type on *Carex praecox* Schreb., Italy, Piemonte, Pinerolo, V.1861, A. Carestia.

Moreaua kungii T. N. Liou & H. C. Cheng, 1949:209. – Type on *Carex* sp., China, Shensi, Chow-chih-hsien, Low-kwan-tai, on river bank, 22.IV.1938, H. W. Kung (55). Isotype in HUV 11698!

Sori on filaments and the base of bracts of staminate flowers, only exceptionally on more or less aborted perigynia, as a black, granular-powdery mass of spore balls concealed by the bracts. Infection systemic. Infected female flowers are more or less completely transformed into male flowers. *Spore balls* globose, ovoid to irregular, 16–45 µm long, yellowish-brown to blackish-brown, persistent, composed of (1–)2–15(–more?) spores. *Spores* subglobose, semiglobose, subcuneiform, polyhedral to irregular, flattened and smooth on the contact sides, convex, thick-walled, finely and densely verruculose on the free surface, 7–14 x 10–16 µm in diameter, light yellowish-brown to dark olivaceous-brown. *Spore germination* results in phragmobasidia on which ovoid basidiospores are produced laterally or often terminally. Basidiospores germinate giving rise to chains or groups of yeast-like cells. After conjugation of basidial cells, or of basidiospores, hyphae may result (Cocconi, 1890:706, Pl. I(3), figs. 1–11; Liou & Cheng, 1949, Pls. IV-VI).

On Cyperaceae: at least on fifteen *Carex* spp. in Europe, Asia, North America.

Further smut fungi belonging to the genus *Moreaua* are:

Moreaua caustidis (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium caustidis* K. Vánky, in Vánky & Websdane, Mycotaxon 58:177, 1996. – Type on *Caustis blakei* Kük., Australia.

Moreaua cyathochaetae (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium cyathochaetae* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon 58:180, 1996. – Type on *Cyathochaeta avenacea* Benth., Australia.

Moreaua epischoeni (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium epischoeni* K. Vánky, Mycotaxon 70:20, 1999a. – Type on *Epischoenus gracilis* Levyns, South Africa.

Moreaua evandrae (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium evandrae* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon 58:175, 1996. – Type on *Evandra aristata* R. Br., Australia.

Moreaua fischeri (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium fischeri* K. Vánky, Mycotaxon 48:29, 1993. – Type on *Rhynchospora plumosa* Ell., USA.

Moreaua gahniae (K. & C. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium gahniae* K. & C. Vánky, in Vánky, Mycotaxon 62:154, 1997a. – Type on *Gahnia radula* (R. Br.) Benth., Australia.

Moreaua gymnoschoeni (K. & C. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium gymnoschoeni* K. & C. Vánky, in Vánky, Mycotaxon 62:163, 1997a. – Type on *Gymnoschoenus sphaerocephalus* (R. Br.) Hooker fil., Australia.

Moreaua kochiana (Gäumann) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium kochianum* Gäumann, Ber. Schweiz. Bot. Ges. 41:179, 1932. – Type on *Schoenus nigricans* L. x *ferrugineus* L., Switzerland.

Moreaua laevigata (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium laevigatum* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon, 56:224, 1995. – Type on *Schoenus laevigatus* W. Fritzg., Australia.

Moreaua lepidospermae (McAlpine) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium lepidospermae* McAlpine, The smuts of Australia, p. 188, 1910. – Type on *Lepidosperma angustatum* R. Br., Australia.

Moreaua littoralis (G. Cunningham) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium littorale* G. Cunningham, Trans. & Proc. New Zealand Inst. 56:77, 1926. – Type on *Cladium huttonii* Kirk. (= *Baumea arthrophylla* (Nees) Boeckeler), New Zealand.

Moreaua mauritiana (H. Sydow) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium mauritianum* H. Sydow, Ann. Mycol. 37:201, 1939. – Type on *Fimbristylis* sp., Mauritius.

Moreaua megaglomerulosa (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium megaglomerulosum* K. Vánky, Mycotaxon 65:147, 1997c. – Type on *Lepidosperma gunnii* Boeck, Australia.

Moreaua melanospora (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium melanosporum* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon 58:170, 1996. – Type on *Mesomelaena graciliceps* (C. B. Clarke) K. L. Wilson, Australia.

Moreaua mesomelaenae (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium mesomelaenae* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon 58:169, 1996. – Type on *Mesomelaena pseudostygia* (Kük.) K. L. Wilson, Australia.

Moreaua muelleriana (Thümen) K. Vánky, **comb. nov.**
Basionym: *Sorosporium muellerianum* Thümen, Flora 61:444, 1878. – Type on *Cladium filum* R. Br. (= *Gahnia trifida* Labill.), Australia.

Moreaua rhynchosporae (Hennings) K. Vánky, **comb. nov.**
Basionym: *Sorosporium rhynchosporae* Hennings, Hedwigia 35:222, 1896. – Type on *Rhynchospora glauca* Vahl (= *Rhynchospora rugosa* (Vahl) S. Gale), Brazil.

Moreaua rhynchosporae-cephalotis (K. & T. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium rhynchosporae-cephalotis* K. & T. Vánky, in Vánky, Mycotaxon 48:29, 1993. – Type on *Rhynchospora cephalotes* (L.) Vahl, Costa Rica.

Moreaua rodwayi (McAlpine) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium rodwayi* McAlpine, The smuts of Australia, p. 189, 1910. – Type on *Lepidosperma laterale* R. Br., Australia.

Moreaua schoeni (K. Vánky & McKenzie) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium schoeni* K. Vánky & McKenzie, in Vánky & Websdane, Mycotaxon 56:227, 1995. – Type on *Schoenus brevifolius* R. Br., New Zealand.

Moreaua tetrariae (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium tetrariae* K. Vánky, Mycotaxon 62:160, 1997a. – Type on *Tetraria capillaris* (F. Mueller) J. M. Black, Australia.

Moreaua tricostulariae (Websdane & K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium tricostulariae* Websdane & K. Vánky, in Vánky & Websdane, Mycotaxon 58:178, 1996. – Type on *Tricostularia neesii* Lehm., Australia.

Moreaua tristis (K. Vánky) K. Vánky, **comb. nov.**
Basionym: *Tolyposporium triste* K. Vánky, Mycotaxon 62:154, 1997a. – Type on *Gahnia tristis* Nees, China.

During work with the smut fungi of New Zealand, an *Anthracoidea* species was found on the endemic *Carex wakatipu* Petrie of the subgen. *Carex*, sect. *Echinolaenae*. No smut fungus has been reported on this sect. of *Carex*. It is described as:

Anthracoidea wakatipu K. Vánky, **sp. nov.**

Typus in matrice *Carex wakatipu* Petrie, New Zealand, South Island, Cardrona Valley, XI.1963, B. P. J. Molly. Holotypus in PDD 23213!, isotypus in Herbario Ustil. Vánky HUV 16724!

Sori in ovariis nonnullis inflorescentiae corpora nigra, dura, globosa, 1–1,5 mm diametro, circum nuces e sporis agglutinatis composita, superficie pulverea formantes. *Sporae* parvae, parum depressae, visu laterali 8–10 µm latae, in visu plano angulares-irregulares, polyangulares, elongatae, nonnunquam apicibus acutis, rarius rotundatae, saepe cum protuberantia una vel illis nonnullis, 10,5–16 x (12–)13,5–20(–24) µm, mediocriter rubrobrunneae; pariete inaequaliter incrassato, 1–2,5 µm, maxime incrassato ad angulos et protuberantias, saepe in area maxime incrassata locis luce refractivis, sine incrassationibus internis, superficie tenuiter, dense verruculosa; linea extrema sporae levis, usque valde tenuiter undulata.

Sori (Fig. 9) in some ovaries of the inflorescence forming black, hard, globose bodies around the nuts, 1–1.5 mm in diameter, composed of agglutinated spores, powdery on the surface. *Spores* (Figs. 6, 7) small, slightly flattened, in side view 8–10 µm wide, in plane view angular-irregular, polyangular, elongated, sometimes with acute tips, more rarely rounded, often with one or several protuberances, 10.5–16 x (12–)13.5–20(–24) µm, medium reddish-brown; wall unevenly thickened, 1–2.5 µm, thickest at the angles and protuberances, often with light-refractive spots in the thickest area, internal swellings lacking; surface finely, densely verruculose, spore profile smooth to very finely wavy.

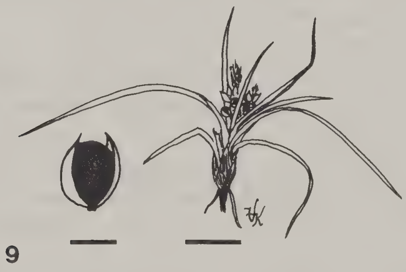

Fig. 9. Sori of *Anthracoidea wakatipu* K. Vánky around the nuts of *Carex wakatipu* Petrie. Enlarged a sorus (type). Bars = 1 mm (left), 1 cm (right).

ACKNOWLEDGEMENTS

I am grateful to Dr. S. Tóth (Gödöllő, Hungary) for providing the Latin descriptions, to Dr. E. H. C. McKenzie (Auckland, New Zealand) for reading the manuscript and serving as pre-submission reviewer, to Dr. K. Websdane (Perth, Australia) for her help in collecting smutted Restionaceae, and to Dr. R. Bauer (Tübingen, Germany) for germination of a *Restiosporium* sp. Part of the work was carried out at the University of Tübingen, Institute of Special Botany and Mycology (director Prof. Dr. F. Oberwinkler).

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MYCOTAXON

Volume LXXIV(2), pp. 357-366 April-June 2000

FURTHER NOTES ON THE GENUS OUDEMANSIELLA FROM SOUTHWESTERN CHINA[1]

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Abstract

Two species of the genus *Oudemansiella* collected from southwestern China are described and illustrated in detail. One species, *O. orientalis*, is new to science, the other, *O. hongoi*, is a first record for China. Specimens studied are deposited in the cryptogamic herbarium of Kunming Institute of Botany (HKAS).

Key words: *Oudemansiella*, *O. orientalis*, *O. hongoi*, new species, new combination, China

A few of the species of *Oudemansiella* occurring in southwestern China were described and reported several years ago (Yang & Zang, 1993). Recently the author has collected another two noteworthy species of the genus from the region. They are reported herein.

1. *Oudemansiella orientalis* Z. L. Yang, *sp. nov.* Figs. 1-6

Pileus 1.5-8 cm latus, convexus vel subplanus, griseolus vel subfulvus, deinde albidus, albus vel cremeus, viscidus vel glutinosus, marginem versus substriatus. Caro tenuis, albida, inodora. Lamellae adnexae, albae vel cremeae, distantes vel subdistantes; lamellulae praesentes. Stipes 2-8 × 0.2-0.8 cm, subcylindricus, ad basim vix incrassatus, subfulvus vel fulvus, deinde albidus vel pallide fulvus, apicem versus pallidior, pubescens; exannulatus; pseudorrhiza absens. Sporae (10.5-)11.5-14.5(-16.5) × (9.0-)9.5-11.0(-12.0) µm, lato-ellipsoidea vel ellipsoidea, interdum lato-amygdaliformes. Basidia 45-60 × 12-15 µm,

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[1] The project supported by a grant of the Foundation for Applied Basic Researches of Yunnan Province (no. 98C026Q) and in part by a grant for Systematic and Evolutionary Biology, Chinese Academy of Sciences.

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clavata, 4-sporigera, raro 2-sporigera. Pleurocystidia 80-120 × 20-30 µm, fusoidea vel subfusoidea, saepe capitata vel subcapitata. Cheilocystidia 50-250 × 10-20 µm, subclavata, subcylindrica, fusoidea vel lanceolata. Epicutis pilei ex hyphis sphaeropedunculatis, latoclavatis vel clavatis erectis composita. Pileocystidia 45-160 × 10-20 µm, lanceolata, lageniformia vel subcylindrica. Fibulae praesentes. Holotypus: Z. L. Yang 2534 (HKAS 32127), 21. IX. 1998, Sanjiangkou Nat. Res., alt. 1800 m, Mugan, Yiliang, Yunnan, China. Ad lignum emortuum.

Etymology: *orientalis*, from the East.

Basidiocarps (Fig. 1) small to medium-sized. Pileus 1.5-8 cm in diam., convex to almost applanate, greyish to brownish (5B2-5B3, Avellaneous, Wood Brown)[3], often becoming whitish to white or cream-coloured (3A2, Cream Color, Chamois) after rainfall, smooth, sometimes rugose in the centre, viscid to strongly glutinous, margin often with radially arranged translucent striations. Context of pileus white; taste mild. Lamellae adnexed, white to cream-coloured, distant to subdistant, with lamellulae. Stipe 2-8 × 0.2-0.8 cm, subcylindrical, brownish to definitely brown (5C6-6C5, Ochraceous-Tawny, Auburn), often becoming whitish, paler towards the apex, pubescent with whitish hairs, without annulus, base of stipe subdiscoid enlarged, without pseudorrhiza. Context of lower part of stipe brown to brownish, apical zone white, hardly fistulate.

Spores (Fig. 2) [140/6/2][4] (10.5-)11.5-14.5(-16.5) × (9.0-)9.5-11.0 (-12.0) µm [Q = (1.06-)1.17-1.39(-1.48), **Q** = 1.28 ± 0.08], broadly ellipsoid to ellipsoid, sometimes broadly amygdaliform, often with a subacute apex but also with an obtusely rounded apex, colourless, hyaline, inamyloid. Basidia (Fig. 3) 45-60 × 12-15 µm, clavate, 4-spored, rarely 2-spored; sterigmata 5-8 µm long; basal clamp connections common. Subhymenium (Fig. 3) not gelatinized, with frequently branching hyphal segments, 3-5 µm wide; clamp connections common. Hymenophoral trama (Fig. 3) consisting of parallel and interwoven hyphae, 3-30 µm wide; clamp connections common. Pleurocystidia (Fig. 3) scattered, 80-120 × 20-30 µm, fusiform to subfusiform, often capitate to subcapitate, hyaline, thin to slightly thick-walled, apex sometimes with hyaline incrustations. Cheilocystidia (Fig. 4) numerous, 50-250 ×

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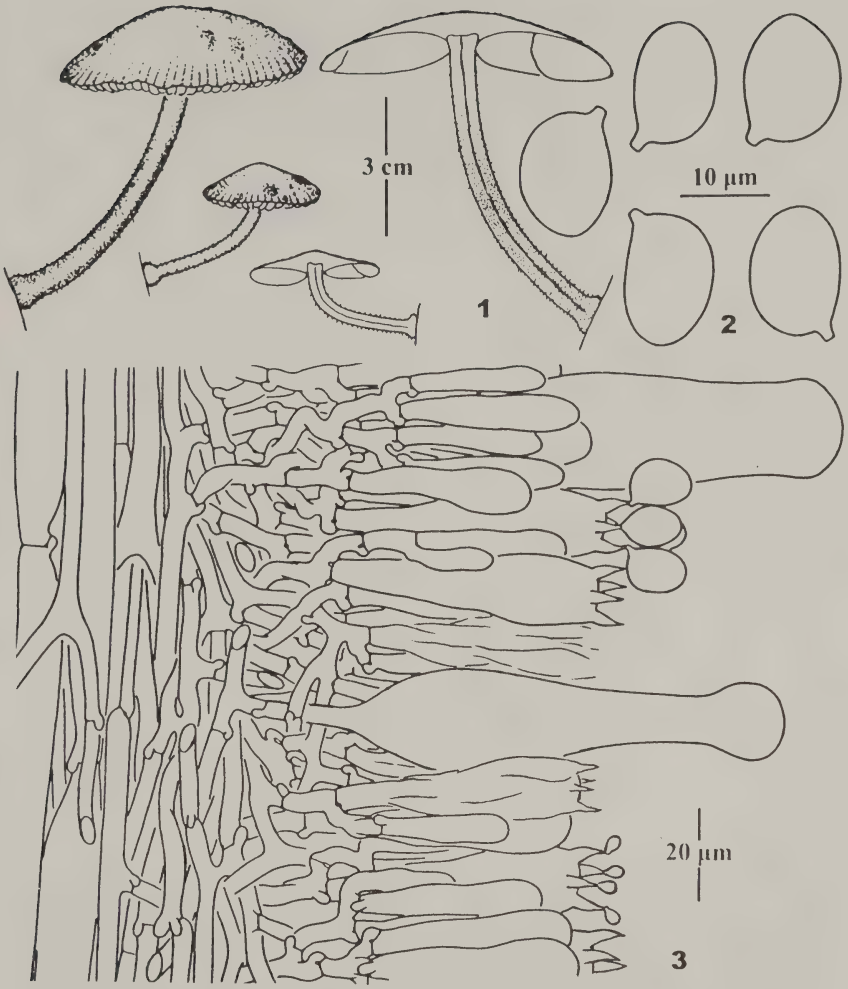
[3] Colour codes of the form e.g. 5B2 are from Kornerup & Wanscher (1981); Colour names with first letters capitalized (e.g. Wood Brown) are from Ridgway (1912).

[4] 140 spores from 6 basidiocarps of 2 collections measured in 5% KOH solution; Q is used to mean "length/width ration" of a spore; **Q** means average Q of all specimens ± sample standard deviation.



Figs. 1-3: *Oudemansiella orientalis* (HKAS 32127, holotype). 1. Basidiocarps; 2. Spores; 3. Hymenophoral trama, subhymenium, hymenium and pleurocystidia.

10-20 µm, subclavate, subcylindrical, fusiform or lanceolate, hyaline, thin-walled, sometimes slightly thick-walled, forming a sterile edge along the margin of lamellae. Pileipellis (Fig. 5) an epithelium made up of sphaeropedunculate, broadly clavate to clavate, thin-walled cells (20-50 × 5-30 µm) often with vacuolar brown pigment; clamp connections common. Pileocystidia (Fig. 5) scattered to fairly abundant, 45-160 × 10-20 µm, lanceolate, lageniform to subcylindrical, thin to slightly thick-

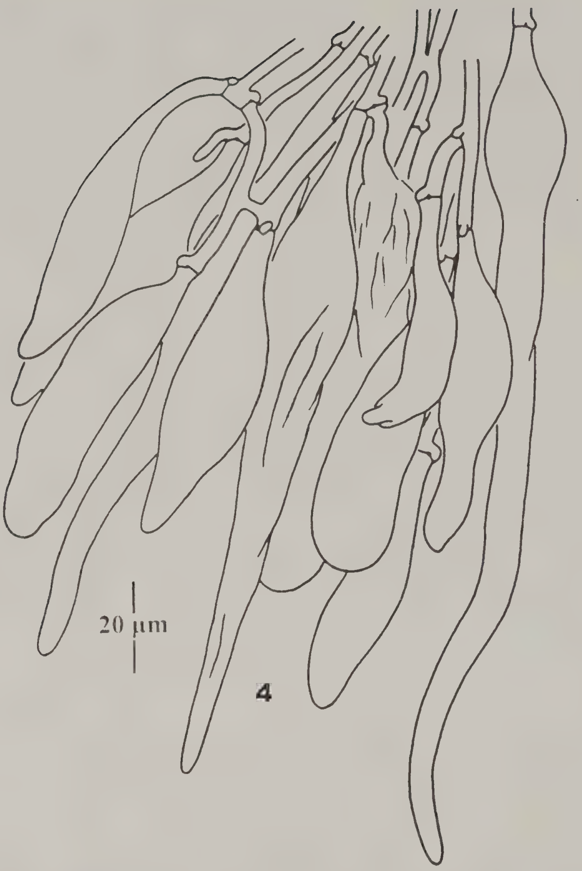
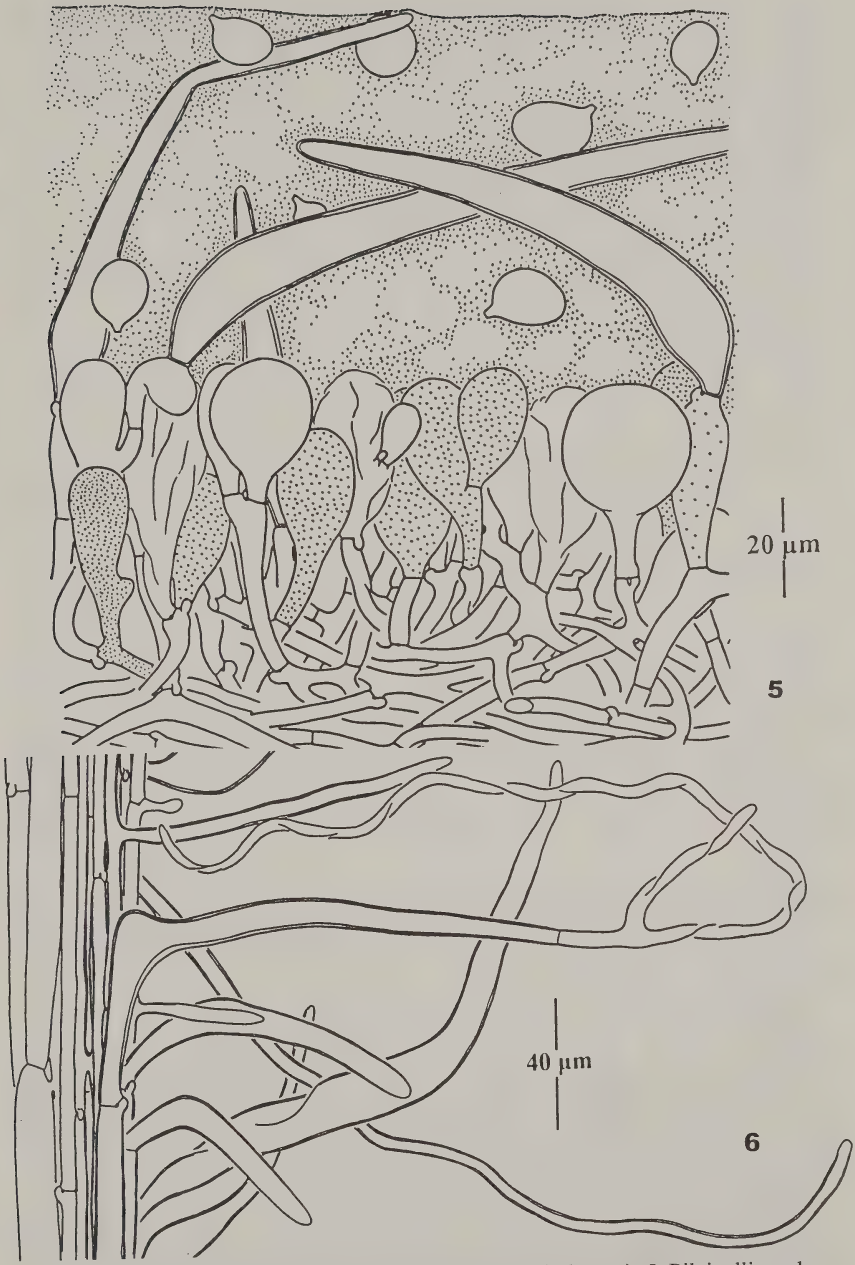


Fig. 4: *Oudemansiella orientalis* (HKAS 32127, holotype). Cheilocystidia.

walled (up to 1 µm thick), often attached on inflated hymeniodermic cells, but also penetrated into the base of epithelium and connected with cylindrical hyphae. Caulocystidia (Fig. 6) 60-450(-650) × 5-20 µm, lanceolate, subfusiform to subcylindrical, hyaline, thin to slightly thick-walled (up to 2 µm thick), sometimes branching, rarely septate. Trama of stipe (Fig. 6) made up of longitudinally arranged hyphae, 2-20 µm wide, thin to slightly thick-walled (up to 1.5 µm thick).

Habitat: On rotten trunk or stump of a broad-leaved tree, in subtropical evergreen broad-leaved forest.
Specimens examined: Yunnan Prov.: Yiliang County, Mugan Township, Sanjiangkou Nature Reserve, alt. 1800 m, 21. IX. 1998, Z. L. Yang 2534 (HKAS 32127, holotype), Z. L. Yang 2535 (HKAS 32021).
Distribution: Only known from the locality cited above.



Figs.5-6: *Oudemansiella orientalis* (HKAS 32127, holotype). 5. Pileipellis and pileocystidia; 6. Trama of stipe and caulocystidia.

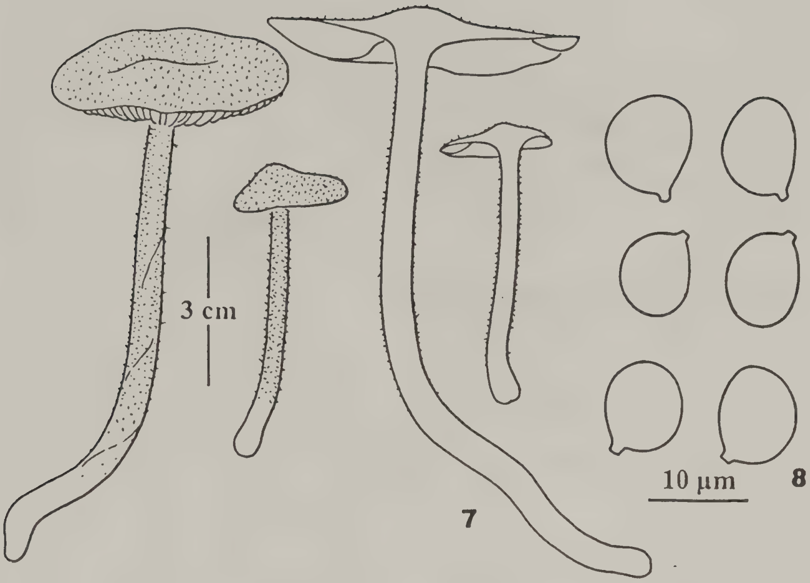
Note: *Oudemansiella orientalis*, being without a pseudorrhiza on the stipe base, is somewhat similar to species of the subgenus *Oudemansiella*, like *O. mucida* (Schrad.: Fr.) v. Höhn. and *O. canarii* (Jungh.) v. Höhn. However, it differs from the two species by its brownish to brown, slender stipe, ellipsoid, significantly smaller spores, and the presence of pileocystidia and caulocystidia. Furthermore, the basidiocarp development of *O. orientalis* appears to be gynmocarpous based upon observations made in the field. These facts suggest that *O. orientalis* should be put in the subgenus *Xerula*. However, it is not easy to place this taxon in the available sections as defined by Pegler & Young (1986). *Oudemansiella orientalis* posses hyaline caulocystidia and thin to slightly thick-walled pileocystidia, which might place it in section *Albotomentosae*, which, however, usually consists of taxa with dry pileus (Pegler & Young, 1986). In this section, *O. orientalis* is similar to *O. caussei* (Maire) Moser ex Clémençon, of which *O. renati* Clémençon and *O. nigra* Dörfelt are synonyms (Boekhout & Bas, 1986). But it differs from *O. caussei* in its viscid to glutinous, paler pileus, stipe without a pseudorrhiza, larger spores, and narrower pileocystidia (see Boekhout & Bas, 1986). Because of its slightly thick-walled pileocystidia, this species may be also put into the sect. *Xerula* (Pegler & Young, 1986), and it is somewhat similar to *O. americana* (Dörfelt) Pegler & Young and *O. hongoi* (Dörfelt) Z. L. Yang. *Oudemansiella orientalis* differs from the latter two species in its viscid to glutinous, paler pileus, and stipe without pseudorrhiza, in its larger spores, differently shaped pleurocystidia, and somewhat thinner-walled pileocystidia (Mitchel & Smith, 1978, Dörfelt, 1981; and see also descriptions of *O. hongoi* below).

2. *Oudemansiella hongoi* (Dörfelt) Z. L. Yang, *comb. nov.* Figs. 7-11

Basionym: *Xerula hongoi* Dörfelt, *Feddes Repert.* **97:** 401, Abb. 2., Taf. 28/Fig. 6 (1986).

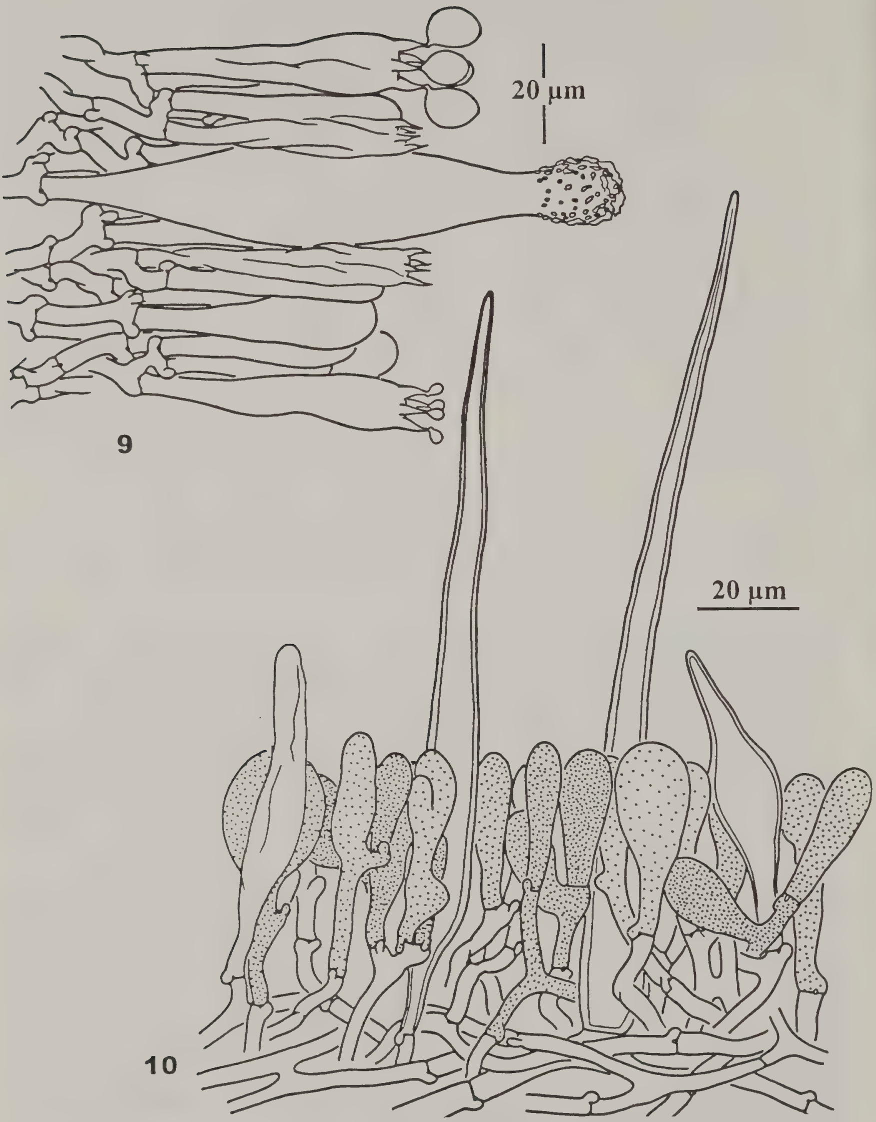
Basidiocarps (Fig. 7) small to medium-sized. Pileus 3-5 cm in diam., convex applanate, often with slightly umbonate centre, not viscid, at first dark grey to blackish, then brown to pale brown, pubescent with whitish hairs, glabrescent. Lamellae adnate, white, rather distant, with lamellulae. Stipe 6-11 × 0.3-0.7 cm, apex whitish, lower part brown, with whitish hairs, with a rudimental pseudorrhiza. Context white, taste mild.

Spores (Fig. 8) [75/3/1] (8.0-)8.5-10.5 × (7.0-)7.5-9.0(-9.5) µm [Q = (1.0-)1.06-1.26(-1.37), **Q** = 1.16 ± 0.06], subglobose to broadly ellipsoid, sometimes broadly amygdaliform, rarely globose, with a subacute or an obtusely rounded apex, colourless, hyaline, sometimes with vacuolar



Figs. 7-8: *Oudemansiella hongoi* (HKAS 32498). 7. Basidiocarps; 8. Spores.

brown pigment, inamyloid. Basidia (Fig. 9) 50 - 65 × 8 -14 µm, clavate, 4-spored; sterigmata 5-6 µm long; basal clamp connections common. Subhymenium (Fig. 9) with frequently branching hyphal segments, 3-5 µm wide; clamp connections common. Hymenophoral trama consisting of parallel and interwoven hyphae, 3-20 µm wide; clamp connections common. Pleurocystidia (Fig. 9) scattered, 65-120 × 15-25 µm, fusiform, usually capitate, often hyaline, sometimes with vacuolar brown pigment, thin to slightly thick-walled (ca. 0.5 µm thick), upper part, especially the apex often with incrustations. Cheilocystidia similar to pleurocystidia, abundant. Pileipellis (Fig. 10) a hymenioderm, made up of broadly clavate to clavate, thin- to slightly thick-walled cells (25-55 × 10-20 µm), most with vacuolar brown pigment; clamp connections common. Pileocystidia (setae) (Fig. 10) 55-150 × 10-15 µm, lanceolate to subfusiform, thin to thick-walled (up to 2.5 µm thick), hyaline or the cell wall of the lower part of pileocystidia becoming brownish pigmented with age. Caulocystidia (Fig. 11) 80-300 × 10-20 µm, often lanceolate, sometimes subfusiform to subcylindrical, hyaline, thin to slightly thick-walled (up to 2 µm thick), unbranching, often caespitose. Trama of stipe (Fig. 11) made up of longitudinally arranged hyphae, 2.5-20 µm wide, thin to slightly thick-walled (up to 1 µm thick), septum often with a clamp connection.



Figs. 9-10: *Oudemansiella hongoi* (HKAS 32498). 9. Hymenium, subhymenium and pleurocystidium; 10. Pileipellis and pileocystidia (setae).

Habitat: On rotten wood among mosses in forest of *Abies* and *Rhododendron*.

Specimen examined: Sichuan Prov.: Xiangcheng County, Daxueshan,

alt. 4100 m, 24. VII. 1998, Z. L. Yang 2415 (HKAS 32498).
Distribution: Japan; new to China.

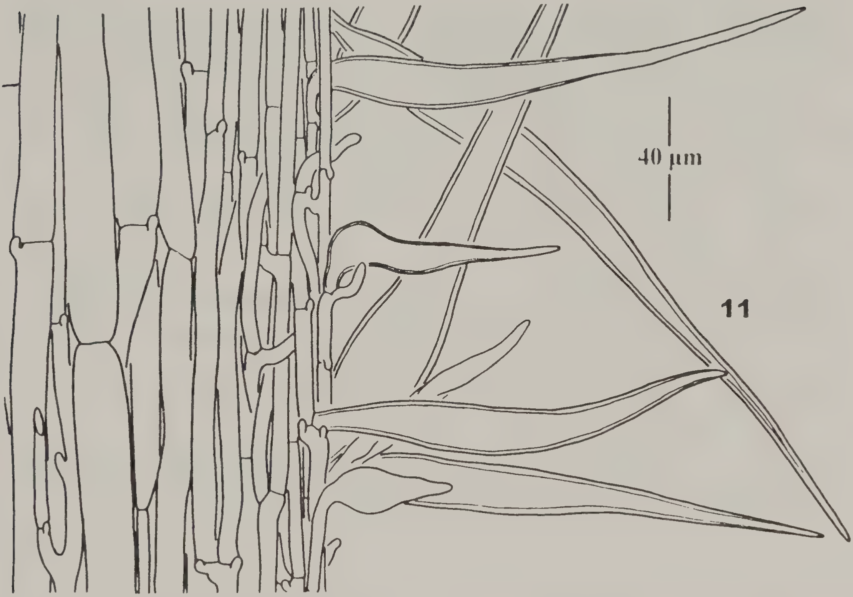


Fig. 11: *Oudemansiella hongoi* (HKAS 32498). Trama of stipe and caulocystidia.

Note: *Oudemansiella hongoi* is closely related to *O. americana* (Dörfelt) Pegler & Young. It differs from the latter in its broader and shorter spores according to the present knowledge. Whether they are conspecific or not, this question is still open. *Oudemansiella hongoi* is also similar to *O. caussei*. But it differs from the latter in its rounder (shorter and broader) spores, usually larger capitated pleurocystidia and cheilocystidia, and narrower pileocystidia with thicker wall (cf. Boekhout & Bas, 1986; Pegler & Young, 1986).

Acknowledgements

I am grateful to Prof. Dr. F. Oberwinkler (Tübingen, Germany) and Prof. M. Zang (Kunming, China) for their guidance. I thank Dr. S. A. Redhead (Ottawa, Canada) very much for serving as reviewer. Dr. M. Weiß (Tübingen, Germany) is acknowledged for correcting the Latin diagnosis.

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MYCOTAXON
Volume LXXIV(2), pp. 367-378 April-June 2000

COMPARATIVE STUDIES ON PUNCTELIA BORRERI, P. PERRETICULATA, AND P. SUBRUDECTA (PARMELIACEAE, LICHENIZED ASCOMYCOTINA) FROM THE IBERIAN PENINSULA

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Abstract

A comparative study on *Punctelia borreri*, *P. perreticulata* and *P. subrudecta* from the Iberian Peninsula has been carried out. New data are incorporated for the differentiation of the three species on the basis of medullary substances, lower cortex colour, thallus morphology and characters of pycnidia and conidia.

Key words: *Punctelia*, Iberian Peninsula.

Introduction

The genus *Punctelia* was segregated from *Parmelia* Ach. by Krog (1982) on the basis of the development of the pseudocyphellae, conidia morphology, chemistry and geographical distribution. As a result of the revision of this genus in the Iberian Peninsula at least three species have been reported: *Punctelia borreri* (Sm.) Krog, *Punctelia subrudecta* (Nyl.) Krog and *Punctelia perreticulata* (Räsänen) G. Wilh. & Ladd.

P. borreri and *P. subrudecta* have traditionally been differentiated by the colour of the lower cortex and the medullary substances: *P. borreri* with dark underside and gyrophoric acid, and *P. subrudecta* with pale underside and lecanoric acid (Hale, 1965 and 1984; Krog, 1982; Krog & Swinscow, 1977; Elix, 1994).

P. perreticulata is a closely related species. Hale (1965) differentiated it from *P. subrudecta* mainly on the basis of the marginal soredia, upper surface scrobiculation and narrower lobes. Wilhelm & Ladd (1987) studied material from the interior highlands of the United States and reported differences also in the ecology of the two species. However other authors have considered this taxon as a synonym of *P. subrudecta* (Krog, 1982; Nimis, 1993). Recently Adler & Ahti (1996) have given new data on the basis of overlooked conidial characters, and they recognise *P. perreticulata* as a distinct species. They noted that the morphological characters used by Hale (1965) are not reliable diagnostic characters for this species, and gave as the only consistent differential character the shape and length of conidia (longer in *P. perreticulata* than in *P. subrudecta*). These authors found differences in length of conidia of *P. perreticulata* between European (M = 7 µm), Australasian (M = 8-10 µm) and American (M = 9-11 µm) collections, and considered them as intraspecific geographical variation.

While revising the genus *Punctelia* in the Iberian Peninsula we realised that there is a great variability in the colour of the lower cortex of the specimens, and that lecanoric acid was present in specimens with a conspicuously dark underside. We also observed that specimens with long conidia, corresponding to *P. perreticulata*, seemed to be morphologically different from the close *P. subrudecta*. For this reason, we have done a comparative study on the chemistry, lower cortex colour, thallus morphology, pycnidia and conidial characters of the three species.

Material and Methods

A total of 63 samples from the Iberian Peninsula have been studied. Material from outside the Iberian Peninsula (included holotypes of *P. borreri* and *P. subrudecta*) has also been studied for comparison. The collections studied are housed at BCC, BM, H, MACB, US, and hb. J. Etayo.

The chemical study has been carried out with thin-layer chromatography using the standard method (Elix & Ernst-Russell, 1993). Chromatographies were done immediately after extraction (5 minutes in acetone), to avoid degradation of the lichen substances. The TLC plates were dried at 60° for 5 minutes before immersion in the solvents to avoid problems with humidity as much as possible.

The conidial length range was calculated from the study of all the Iberian samples with pycnidia: 7 of *P. subrudecta*, 5 of *P. borreri* and 3 of *P. perreticulata*. At least 10 conidia of each sample were first drawn at 1600x using a drawing tube, and then measured. In the expression of the length of conidia the range is given after elimination of the 10 % of the values at the extremes. Following Adler & Ahti (1996) we use the mode for comparisons between specimens.

Results

Chemical Substances: All the samples contained atranorin. *P. subrudecta* and *P. perreticulata* contained lecanoric acid and orsellinic acid (minor substance). *P. borreri* presented always lecanoric, gyrophoric, orcynil lecanorate and orsellinic acid (minor substance). Therefore, the presence of orcynil lecanorate and gyrophoric acid are diagnostic characters for *P. borreri*, while *P. subrudecta* and *P. perreticulata* cannot be differentiated by means of chemical substances. In case the lobes had a different lower cortex colour than the centre of the thallus, their chemical composition was studied independently, but no differences were observed in the chemistry of different parts of a same thallus. It is remarkable that lecanoric acid was present in all the samples.

Colour of the Lower Cortex: The colour of the lower surface of the different samples showed great variability from the lobes margins to the centre of the thallus. In *P. subrudecta* and *P. perreticulata,* the central lower cortex is always tan or light brown, whereas the lobes can vary from white to brown, dark brown or even black. In *P. borreri,* the lower cortex in the central part of the thallus is always black or at least dark brown, whereas the lobes can vary from black or dark brown to light brown or even white in some specimens. Although occasionally the same colours can be found on the underside of the three species, there is always a different colour gradient from the periphery to the centre of the thallus. In *P. borreri*, the underside darkens towards the centre. In *P. subrudecta* and *P. perreticulata* the underside is homogeneously pale or lighter towards the centre.

The different colour of the lobe underside in respect to the central surface can extend to a great proportion of the thallus. For this reason, a study of poor samples of thalli which consist mainly of lobes can induce mistakes.

Surface Morphology: The surface varied from smooth to scrobiculated and foveolated. Scrobiculation is often difficult to observe due to spread of soralia over big areas of the thallus. For this reason, the upper surface characters are best observed on the peripheral lobes. All the samples of *P. borreri* always present peripheral lobes with a smooth upper surface. *P. perreticulata* is characterised by a conspicuously scrobiculate to foveolate upper surface. *P. subrudecta* is the most variable species. It usually presents peripheral lobes with a smooth surface, but in some specimens some of the lobes present scrobiculation. Such lobes are usually truncate, and with abundant elevated pseudocyphellae. In fact, in *P. subrudecta* scrobiculation seems to be a consequence of the elevation of elongated pseudocyphellae, while in *P. perreticulata* the elevations of the upper cortex do not usually have pseudocyphellae. In any case, scrobiculation is a difficult character to use for distinction between *P. subrudecta* and *P. perreticulata*, although in the former it is present occasionally and in the latter it is a constant and conspicuous character.

The peripheral lobes of all the specimens of *P. borreri* and *P. perreticulata* are pruinose, while in the case of *P. subrudecta* the lobes are always epruinose. Pruina give the lobes a glaucous colour when fresh, and is usually abundant, although not always present in all the lobes of the same thallus.

The three species have laminar pseudocyphellae, which are orbicular or elongate. In *P. borreri* they are very abundant on the surface of peripheral lobes, where they are mainly orbicular, with a diameter up to 300 µm. In *P. subrudecta* orbicular pseudocyphellae has a diameter up to 100 µm, and soon developed into soralia near the lobe margins. Elevated pseudocyphellae are present in the ridges formed as a result of the occasional scrobiculation of some lobes. In *P. perreticulata*, pseudocyphellae were found to be very infrequent. The presence of a reticulum of pseudocyphellae (similar to that of *Rimelia reticulata*) is possible in the three species, but while in *P. subrudecta* and *P. borreri* it is present only at the lobe margins, it is more abundant all over the surface of some lobes of *P. perreticulata*.

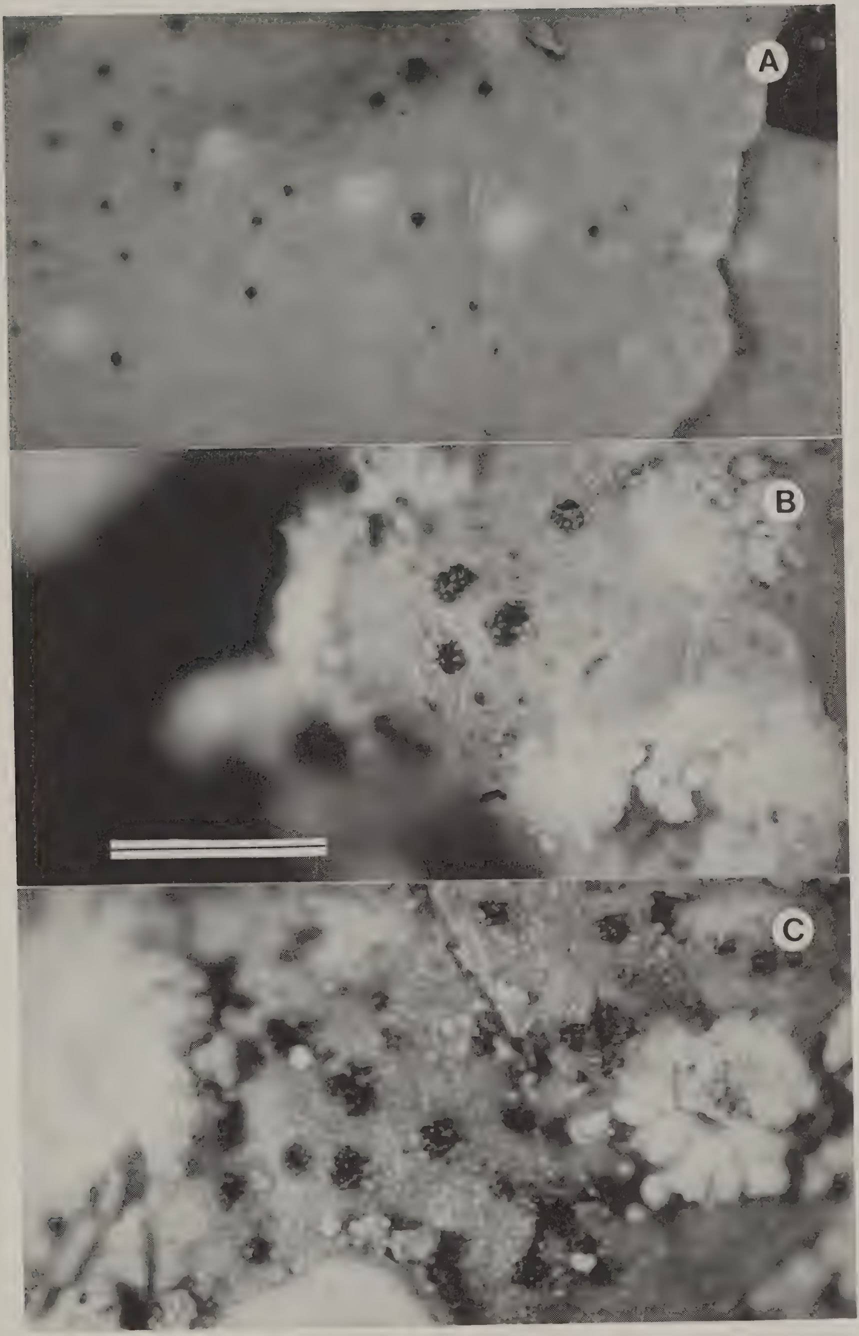
No differences between the species were found in the location of soralia, which are marginal and laminar. While some specimens showed discrete and well delimited soralia, some others had large areas of the thallus covered by coalescent soralia. Nevertheless, this variation occurred in all the three species. The soredia are farinose to coarsely granular, and can develop into pseudoisidia. Little lobes proliferating between these pseudoisidia in the central part of the thallus were observed in the three species.

Pycnidia: The pycnidia observed in these species seem to belong to the *Lobaria-Type*, described by Vobis (1980), especially for the presence of dark coloured cortical cells around the ostiole, which can clearly be differentiated from the rest of the cortex. Conidiophores of this type of pycnidia are expected to belong to the type VII, as mentioned by Vobis (op. cit.). However, the conidiophores observed in our samples, are more like in type VI, *sensu* Vobis (op. cit.).

From the samples examined, differences between two kinds of pycnidia were observed and described as follows:

-Borreri-Type: They correspond to the pycnidia of *P. borreri*. They were seen as punctiform black spots (25-55 µm) immersed in the thallus. Pycnidia wall dark coloured and with dark-brown cortical cells around the ostiole. They were mainly located in the peripheral lobes (Fig. 1A).

Fig. 1. Thallus surface showing the pycnidia of: A.- *Punctelia borreri*. B.- *P. perreticulata* and C.- *P. subrudecta*. Scale bar = 0,5 mm.


A
B
C

-Subrudecta-Type: They correspond to the pycnidia of *P. subrudecta* and *P. perreticulata*. They were seen as prominent black spots (90-125 µm). Pycnidia wall pale coloured and with brown-coloured cortical cells around the ostiol, that in this kind of pycnidia grow to form a clypeus, and appears for this reason as surrounded by a brown ring (Figs. 1B and 1C). Pycnidia aremainly situated in central parts of the thallus, where they are finally confluent.

Conidia (Fig. 2): There is a transition of conidial length between the three species. *P. subrudecta* has short unciform conidia with a length range of (3,6-)4,1-5(-6,8) µm, M = 4,5-5 µm (n = 128). *P. borreri* has mainly short filiform conidia, but with a certain proportion of unciform conidia also present, with a conidial length of (4,5-)5-6,8(-7,3) µm, M = 5-6,4 µm (n = 124). *P. perreticulata* has longer unciform to filiform conidia, (5,9-)6,4-8,2 (-9) µm, M = 6,4-7,3 µm (n = 50); (n = number of conidia measured).

From our results, the Iberian specimens of the three species can be differentiated by means of the chemical and morphological characters shown in Table 1.

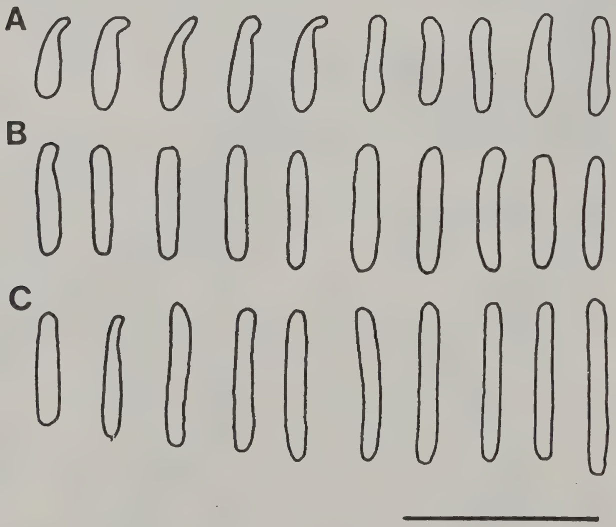


Fig. 2. Conidia of: A.- *Punctelia subrudecta*. B.- *P. borreri* and C.- *P. perreticulata*. Scale bar = 10 µm.

	P. borreri	*P. perreticulata*	*P. subrudecta*
Medullary Substances	Lecanoric, orsellinic and gyrophoric acids, and orcynil lecanorate	Lecanoric and orsellinic acids	Lecanoric and orsellinic acids
Lower Cortex Colour	Darkening towards the centre	Lighter towards the centre	Lighter towards the centre
Peripheral Lobes	Pruinose. Never scrobiculate, with abundant orbicular pseudocyphellae	Pruinose. Conspicuously scrobiculate to foveolate, pseudochypellae scarce	Epruinose. Only occasionally scrobiculate, and then when elevated pseudocyphellae
Pycnidia	Borreri-Type	Subrudecta-Type	Subrudecta-Type
Conidia	(4,5-) 5-6,8 (-7,3) µm M = 5-6,4 µm	(5,9-) 6,4-8,2 (-9) µm M = 6,4-7,3 µm	(3,6-) 4,1-5 (-6,8) µm M = 4,5-5 µm

TABLE 1. Main distinguishing characters of *Punctelia borreri*, *P. perreticulata* and *P. subrudecta*.

Discussion

Our chemical results, according with Spier (1994), confirm the presence of lecanoric acid in *P. borreri*. It is remarkable to note the constant presence of this substance in all the samples of this species, including the holotype specimen. In no case seemed lecanoric acid to be an artefact due to the TLC methodology, but another secondary metabolite. Lecanoric and gyrophoric acids are substances of the same metabolic pathway, so it is not improbable to find them together. Species with gyrophoric acid usually have also lecanoric and orsellinic acids (Kümmerling, 1991). On the contrary, species containing lecanoric acid always contain orsellinic acid, but gyrophoric acid is absent (Leuckert, 1985). Tønsberg (1992) noted that in species with gyrophoric acid as a major substance, lecanoric acid occurred as a constant satellite substance in trace amounts or in a concentration more or less equal to that of gyrophoric acid.

The lower cortex colour is normally used to differentiate *P. borreri* from *P. subrudecta*. However, Spier (1994), when dealing with Dutch specimens of *P. borreri,* found a great variation in the lower cortex colour and could not correlate it with the presence of lecanoric or gyrophoric acids. In our opinion, a good character to differentiate *P. borreri* from the other two species is the variation in colour intensity from the lobe margins to the centre of the thallus.

The apparent correlation between the presence of lecanoric acid and a pale underside (*P. subrudecta*) and that of gyrophoric acid and a dark underside (*P. borreri*) was noted by Hale in 1965, and since then it has been accepted by later authors. This correlation has been accepted as a general rule in the genus *Punctelia* (Hale, 1984 and Elix, 1996), although with some exceptions like *Punctelia novozelandica*, which has a black underside and produces lecanoric acid (Elix & Johnston, 1988). From our results, it seems that in these three species, the correlation would also not be true.

The dark colour of the underside of these species is due to a brown wall pigment, observed in the lower cortex in thin sections of the thallus. We do not know the chemical composition of this brown pigment, which is present in most of the samples at least in the edge of the lobes, but in the case of *Parmelia s. str.* it has been related to the presence of atranorin (Poelt & Leuckert, 1993), which would be substituted by this pigment. Spier & van Herk (1997) suggest that the colour of the underside in *P. borreri* may change with the age of the thalli, the old ones being dark coloured. This would explain that within a thallus of *P. borreri* the periphery was paler than the centre (which is older). In the case of *P. subrudecta* and *P. perreticulata* this explanation would not be valid, as these species tend to darken towards the periphery. We do not know the factors that determine the higher or lower concentration of the brown pigment, and its deposition in certain areas.

Characters of the upper surface have classically been used for differentiation of *P. subrudecta* and *P. perreticulata* (Hale, 1965, Wilhelm & Ladd, 1987). Adler & Ahti (1996) noted that scrobiculation and elevation of pseudocyphellae seemed to be consequences of environmental factors, particularly the type of substratum, and that it was not a taxonomically useful character to delimit *P. perreticulata*. They gave as the only consistent differential character between *P. perreticulata* and *P. subrudecta,* the shape and length of conidia. In the Iberian specimens examined, we observed morphological differences between the samples with short and unciform conidia (*P. subrudecta*) and the ones with long filiform conidia (*P. perreticulata*), which presented a much more foveolated or scrobiculated surface, and less pseudocyphellae. Scrobiculation was seen in epiphytes as well as in saxicolous specimens, so it doesn't seem to be directly correlated with the type of substratum. The Italian and French *P. perreticulata* examined for comparison had a conidial range identical to the ones of the Iberian samples, that correspond to the range given by Adler & Ahti (op. cit.) for European *P. perreticulata*. These samples were also morphologically identical to the Iberian ones, only differing in the presence of pruina, which in the specimens collected by Sbarbaro from Italy was only present at the margin of the lobes, while in the Spanish specimens it covered the lobes surface completely. Nevertheless, material labelled as *P. perreticulata* from America and New Zealand with filiform long conidia was heterogeneous, some samples being identical in morphological characters to the European *P. perreticulata*, and others very different in lobe morphology to our concept of this species, and more similar to the variable *P. subrudecta*. These last specimens had longer conidia than the European *P. perreticulata,* what is considered by Adler & Ahti (op. cit.) as intraspecific geographic variation. We are of the idea that more taxa might be involved in the samples with long conidia. Nevertheless, more studies with specimens with conidia are necessary to clarify the identity of *P. perreticulata* and *P. subrudecta* in terms of morphology in a world context.

***Specimens examined*:**

Punctelia borreri: **EUROPE: England**: Sussex (BM-holotypus). **Portugal**: Coimbra, Beira Litoral, on *Alnus cordata* at the Jardín Botánico, 1990 (MACB). **Spain**: Andalucía: Cádiz, Jerez de la Frontera, road C3331, km 41, 675 m, on *Crataegus monogyna*, 1994 (BCC-Lich.13186); Aragón: Zaragoza, Cariñena, Sierra de Algairon, Puerto de Codos, 850 m, on *Quercus ilex* subsp. *ballota*, 1992 (MACB 50679). Catalunya: Barcelona, El Bruc, 500 m, on *Quercus ilex*, 1978 (BCC-Lich.11653); on *Pinus halepensis*, 1980 (BCC-Lich.11656); Fogars de Montclús, road from Sant Celoni to Santa Fe del Montseny, on *Castanea sativa,* 1984 (BCC-Lich.11159); road to

Mosqueroles, on *Quercus suber*, 1985 (BCC-Lich.3810); Pantà de Foix, turó de la Picarola, 200 m, on *Quercus ilex*, 1997 (BCC-Lich.3190); Sant Llorenç del Munt, Cavall Bernat, 900 m, on *Quercus ilex*, 1997 (BCC-Lich.13192); Sant Bernat de Montseny, 700 m, on *Quercus ilex*, 1996 (BCC-Lich.13197); Sant Martí del Montnegre, saxicolous, 450 m, 1989 (herb. Barbero 480, 485, 487); Sant Martí de Montnegre, 500 m, on *Quercus ilex*, 1996 (BCC-Lich.13187); Orrius, Font de Sant Bartomeu, saxicolous, 1979 (BCC-Lich.1274); Girona, Albanyà, ermita de Sant Martí Corsavell, 600 m, on *Quercus ilex,* 1995 (BCC-Lich.13196); Castelló d'Empúries, Les Torroelles, 100 m, on *Ficus carica*, 1981 (BCC-Lich.8638); on *Olea europaea*, 1981 (BCC-Lich.8651); saxicolous, 1981 (BCC-Lich.8896); Montagut, Oix, 500 m, on *Quercus ilex,* 1981, BCC-Lich.10374; Pantà de Susqueda, Bosc del Cuminal, 700 m, on *Quercus ilex*, 1996 (BCC-Lich.13184); Tarragona, Poblet, La Pena, 700 m, on *Quercus ilex*, (BCC-Lich.3342). Galicia: A Coruña, Santiago de Compostela, Campus Universitario, 245 m, on *Robinia pseudoacacia,* 1984 (BCC-Lich.1829, MACB 16743). Navarra: Elzancha, on *Quercus robur* (hb. J. Etayo); Elzancha, on *Malus domestica* (hb. J. Etayo); Zugarramurdi, 209 m, on *Quercus robur* (hb. J. Etayo); Echauri, 960 m, on *Quercus coccifera* (hb. J. Etayo).

Punctelia perreticulata: **EUROPE: Spain**: Catalunya: Barcelona, Sant Climent, on *Ceratonia siliqua*, 1995 (hb. Valverde); Olesa de Montserrat, Bosc del Gavatx, saxicolous, 1984 (BCC-Lich); corticolous (BCC-Lich.); Tarragona, Paüls, Pla de la Mola, on *Pinus sylvestris*, 1990 (BCC-Lich.6173); Montsagre de Paüls, 950 m, on *Pinus sylvestris,* 1990 (BCC-Lich. 5832). **Italy:** Liguria, Spotorno, 1935 (H); on mosses, 1936 (BCC-Lich. 1700, H, US); on mosses, 1936 (H); on mosses, 1944 (H); saxicolous, 1951 (US); on *Frullania* sp., 1944 (US); saxicolous, 1952 (US). **France**: Hérault, 1964 (H; US). **NORTH AMERICA**: **USA**: California: Yosemite Valley (BM-herb. J. Stirton) Texas, Hamilton's Pool, 1976 (H); Crockett County, on *Juniper*, 1977 (H). **NEW ZEALAND**: Nelson, near Brightwater, on toatara and beech trees, 1954 (BM); Otago, Dunedin, near Flagstaff, Whare Flats, on old conifer stump, 1962 (BM); Canterbury, Timaru, Temuka, on *Nothofagus*, 1958 (BM).

Punctelia subrudecta: **AFRICA:** Isle St. Paul, 1874-75 (H-Nyl-Holotypus). **EUROPE: Spain:** Andalucía: Cádiz, Jerez de la Frontera, road from Alcalá de los Gazules to Puerto Galis km 16, Canuto del Caballo, 420 m, on *Erica*, 1994 (BCC-Lich.13185); on *Phillyrea media* (BCC-Lich.13189); road C3331 km 41, 675 m, on *Crataegus monogyna*, 1994 (BCC-Lich.13188). Cantabria: Santander, Comunidad de Campo de Cabuérnaga, Río Saja, Monte de la Canal del Infierno, 970 m, on *Fagus sylvatica,* 1994 (MACB 56249). Castilla

- La Mancha: Ciudad Real, Fuencaliente, Valle de Navalmanzano, 1000 m, on *Quercus ilex*, 1991 (MACB 43729). Catalunya: Barcelona, Llinars del Vallès, 250 m, saxicolous, 1981 (BCC-Lich.2286); Vilada, road to Borredà, 750 m, on *Pinus sylvestris*, 1981 (BCC-Lich.11458); Fogars de Montclús, road from Sant Celoni to Santa Fe del Montseny, on *Castanea sativa,* 1984 (BCC-Lich.11159); Dosrius, saxicolous, 1988 (herb. Barbero); Sant Llorenç del Munt, Cavall Bernat, 900 m, on *Quercus ilex*, 1997 (BCC-Lich 13193); Sant Pol de Mar, El Farrell, saxicolous, 1987 (hb. Barbero); Pantà de Foix, turó de la Picarola, 200 m, on *Quercus ilex*, 1997 (BCC-Lich. 13191); Girona, Albanyà, ermita de Sant Martí Corsavell, on *Quercus ilex,* 1995 (BCC-Lich.13194); Beuda, 500 m, on *Quercus ilex,* 1995 (BCC-Lich.13195); Roses, Sant Sebastià, 390 m, 1983 (BCC-Lich.11623, 11629); La Rejolera, on *Tamarix*, 1981 (BCC-Lich.11635); Tossa de Mar, Cala Bona, 10 m (BCC-Lich.11514); Cantallops, ermita de Santa Llúcia, 250 m, on *Quercus suber,* 1985 (BCC-Lich.3828, 3829); Tarragona, Punta de la Mora, 10 m, on *Pinus halepensis,* 1987 (BCC-Lich.4010); Pobla de Benifassà, 910 m, on *Quercus ilex*, 1990 (BCC-Lich.5825); Roquetes, Barranc del Farrubio, 150 m, on *Olea europaea,* 1987 (BCC-Lich.5870); Montsagre de Paüls, 950 m, on *Pinus sylvestris,* 1990 (BCC-Lich.5832bis). Navarra: Robledal de Orgui, Lizaso, 500 m (hb. J. Etayo); Landíbar, 100 m, on *Quercus robur* (hb. J. Etayo); Goizueta, 200 m, on *Quercus robur* (hb. J. Etayo); Monte del Setuain, 620 m (hb. J. Etayo); Elzancha, on *Quercus robur* (hb. J. Etayo).

Acknowledgements

We would like to acknowledge the keepers of the herbaria BCC, BM, H, MACB, US, and hb. J. Etayo for the loan of specimens. We are indebted to Dr J.A. Elix, who kindly sent us an extraction of orcinyl lecanorate. Financial support has been afforded by the *Comissionat per a Universitats i Recerca* (Catalan Goverment) and by the Spanish *Dirección General de Investigación Científica y Técnica*.

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MYCOTAXON

Volume LXXIV(2), pp. 379-390 April-June 2000

SPECIES OF ANTHOSTOMELLA FROM PORTUGAL, INCLUDING A. CYPERACEICOLA SP. NOV. AND A. SCIRPI SP. NOV.

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Abstract

Species of *Anthostomella* reported from Portugal have been re-examined. Two species have been transferred to other genera, and two species, one forma and one variety are synonymized. There are also five new records for Portugal identified from collections in herbaria. The new species *A. cyperaceicola* from *Cyperaceae* and *A. scirpi* from *Scirpus* are also described and illustrated. *Anthostomella* species known from Portugal are listed and a key to the known species of *Anthostomella* in Portugal is also provided.

Key words: *Anthostomella*, new records, new species, Portugal, Xylariaceae.

Introduction

Anthostomella Sacc. is placed in family Xylariaceae in order Xylariales, and comprises ca 300 species (Lu *et al.*, 1998). The genus has been partially monographed by Francis (1975) and Hyde (1996), however, no complete monograph exists (Lu & Hyde, 1998).

Over 2500 specimens borrowed from 30 herbaria have been examined, including 250 types of most described taxa and representatives of related genera. In this paper, the species of *Anthostomella* described or known from Portugal have been treated.
A list of the *Anthostomella* species known from Portugal is given in Table 1 and a key is also provided.

Material and Methodes

Specimens of *Anthostomella* known from Portugal were borrowed from IMI, K, LISE, NY, S and W. Examination was carried out by rehydrating dried materials in distilled water. Ascospores, asci and sections of ascomata were mounted in distilled water for observation, microphotography and measurement. Ascal apical rings were stained using Melzer's solution. Sections of ascomata were made on a cryotome and mounted with O. C. T. compound.

Taxonomy

Key to the species of *Anthostomella* known from Portugal

1. Ascospores with a dwarf cell..2
1. Ascospores lacking a dwarf cell..4

2. Ascospores longer than 20 µm, 22.5-30 x 7.5-11.5 µm, inequilaterally oblong-ellipsoidal..*A. appendiculosa*
2. Ascospores shorter than 20 µm..3

3. Ascospores 10.5-13 x 5-5.5 µm, ellipsoidal, lacking a germ slit..*A. clypeata*
3. Ascospores 12-17.5 x 5-8 µm, inequilaterally ellipsoidal, germ slit straight..*A. tomicoides*

4. Asci lacking an apical apparatus..5
4. Asci with a J+ subapical ring..7

5. Ascospores longer than 17 µm, 17.5-21.5 x 7.5-10.5 µm, broadly inequilaterally ellipsoidal, surrounded by a mucilaginous sheath which is wider in the middle..*A. smilacis*
5. Ascospores shorter than 17 µm..6

6. Ascospores 7.5-11 x 4-5 µm, ellipsoidal with two sides parallel, lacking a sheath..*A. sphaeroidea*
6. Ascospores 14-16.5 x 5-6.5 µm, ellipsoidal with one side flattened and tapering ends, surrounded by a mucilaginous sheath..*A. scirpi*

7. Asci with a wedge-shaped subapical ring, ascospores 13.5-18 x 7.5-11.5 x 4.5-6.5 µm, variable in shape, mostly ellipsoidal with one side flattened

to inequilaterally ellipsoidal...*A. cyperaceicola*
7. Asci with a discoid subapical ring...8

8. Ascospores thick-walled..9
8. Ascospores thin-walled..10

9. Ascospores 7.5-12.5 x 5-6.5 x 2.5-4 µm, ellipsoidal or oblong-ellipsoidal
....*A. tenacis*
9. Ascospores 17.5-21.5 x 8-9.5 µm, ellipsoidal.......................*A. delitescens*

10. Ascospores verrucose-walled, 12-17.5 x 5-10 µm, inequilaterally
ellipsoidal ....*A. consanguinea*
10. Ascospores smooth-walled, 14-19 x 7.5-10 µm, ellipsoidal......*A. conorum*

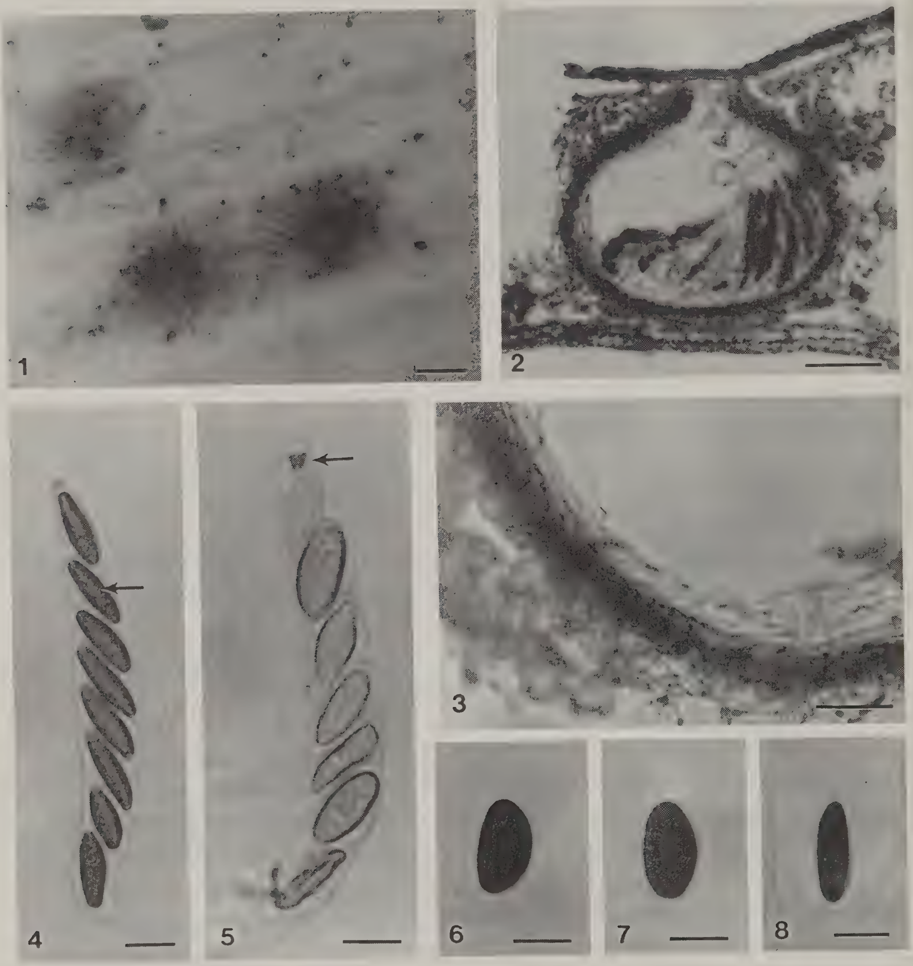
Anthostomella cyperaceicola B. S. Lu & K. D. Hyde, sp. nov. Figs 1-8

Etym.: in reference to the host family on which the fungus was found.

Ascomata 180 µm diam, 160 µm alta, immersa, globosa, ostiolata. Asci 87.5-112.5 x 11.5-12.5 µm, 8-spori, apparatu subapicale, J+, cuneato, 2-2.5 µm diam, 2.5-3 µm alto praediti. Ascosporae 13.5-18 x 7.5-11.5 x 4.5-6.5 µm, variabiles in figuro, late ellipsoideae unilateraliter applanatae vel inaequilateraliter ellipsoideae, fissuro germine praeditae.

Ascomata immersed, visible as darkened, slightly raised areas on the host, clustered or mostly solitary (Fig. 1); in vertical section ca 180 µm diam, 160 µm high, globose, dark brown, coriaceous, with a central periphysate ostiole, ca 20 µm diam, 30 µm high (Fig. 2). Peridium 10-15 µm wide, comprising several layers of compressed cells, walls hyaline at the inside, and brown to dark brown and thick-walled towards the outside (Fig. 3). Paraphyses 5-5.5 µm wide at the base, filamentous, flexuose, septate, numerous and embedded in a gelatinous matrix. Asci 87.5-112.5 x 11.5-12.5 µm ($\bar{x}$ = 101.3 x 12.1 µm, n = 10), 8-spored, broadly cylindrical, pedicellate, unitunicate, apically rounded, with a J+, wedge-shaped, subapical ring, 2-2.5 µm ($\bar{x}$ = 2.4 µm, n = 10) diam, 2.5-3 µm ($\bar{x}$ = 2.5 µm, n = 10) high (Figs 4, 5). Ascospores 13.5-18 x 7.5-11.5 x 4.5-6.5 µm ($\bar{x}$ = 16 x 9 x 5.8 µm, n = 25), overlapping uniseriate, shape variable, mostly broadly ellipsoidal with one-side flattened to inequilaterally ellipsoidal, brown, unicellular, smooth-walled, lacking a mucilaginous sheath, germ slit straight, ventral (Figs 6-8).

Holotype: Portugal, Estremadura, Cascais (Guineho) Province, on *Scirpus* sp.,



Figs 1-8. *Anthostomella cyperaceicola* (from holotype). 1. Appearance of ascomata on the host surface. 2. Section of ascoma. 3. Peridium. 4, 5. Asci with a J+, wedge-shaped, subapical ring (arrowed in 5). 6-8. Ascospores. Note the lack of a mucilaginous sheath, and straight germ slits (arrowed in 4). Scale bars: 1 = 500 μm, 2 = 50 μm, 3-8 = 10 μm.

27 Mar. 1963, M. S. Dias & M. T. Lucas 1765 (LISE 62896).

Other specimens examined: Portugal, Estremadura, Sintra, on unknown Cyperaceae, 17 Aug 1965, B. d'Oliveira S. (LISE 65641, deposited as *A. tomicum*); UK, Wales, Pembrokeshire, Freshwater Bay West, on *Phragmites communis*, 8 Aug 1928, P. G. M. Rhodes 3743 (W 20786, deposited as *A. tomicum*).

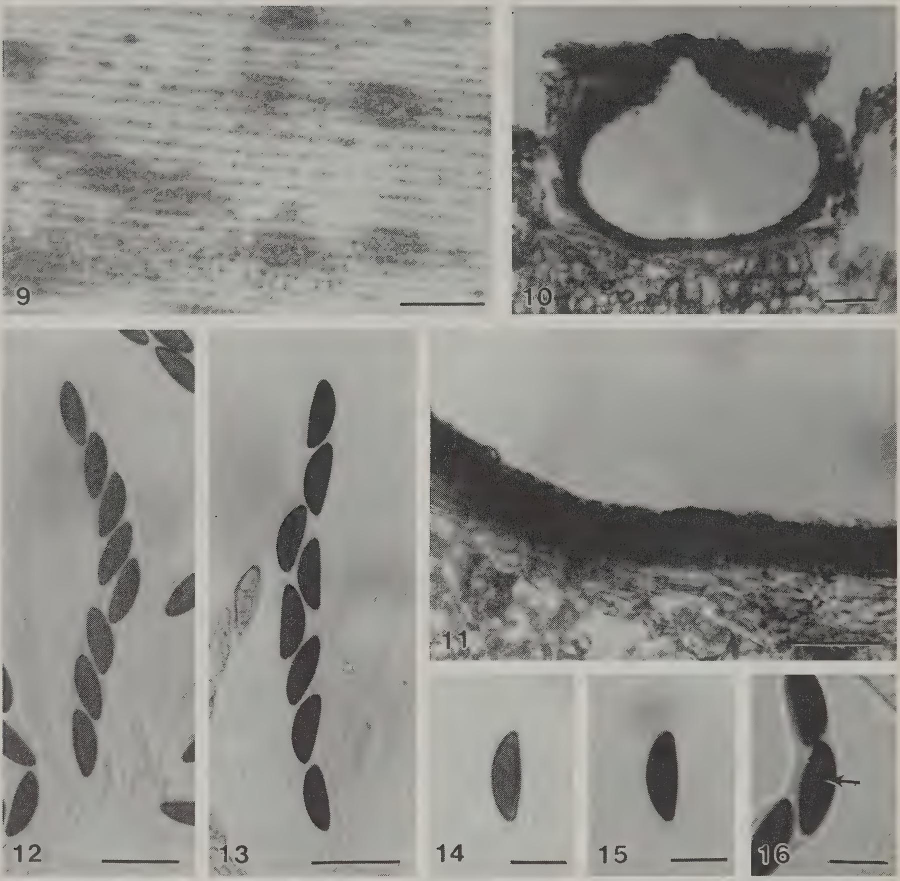
Anthostomella cyperaceicola differs from *A. tomicum* (Lév.) Sacc., as ascospores in *A. cyperaceicola* are variable in shape, mostly broadly ellipsoidal with one side flattened to inequilaterally ellipsoidal, and narrower ventrally, while those in *A. tomicum* are ellipsoidal. In addition, asci in *A. cyperaceicola* are shorter and wider (87.5-112.5 x 11.5-12.5 µm, $\bar{x}$ = 101.3 x 12.1 µm), while those in *A. tomicum* are longer and narrower (132.5-177.5 x 10-11.5 µm, $\bar{x}$ = 150.5 x 10.3 µm) [Material examined: On *Scirpusholoschoenus* (as *Juncus acutus*), Desmazières, *Plantes Crypt. France*, Ed. I. Ser. 1 (1825-1851), no. 1776, ex herb PC (IMI 205739, isotype of *Sphaeria tomicum*)]. *Anthostomella cyperaceicola* is distinct from *A. flagellariae* (Rehm) B. S. Lu & K. D. Hyde as ascospores in *A. cyperaceicola* are mostly broadly ellipsoidal with one side flattened to inequilaterally ellipsoidal, while those in *A. flagellariae* are broadly ellipsoidal with two sides somewhat parallel [Material examined: Philippines, Los Baños, Luzon, Laguna Province, on dead stem of *Flagellaria indica*, 14 Feb 1913, S. A. Reyes & C. F. Baker 1576b (S, holotype of *Anthostoma flagellariae*).

Anthostomella scirpi B. S. Lu & K. D. Hyde, sp. nov. Figs 9-16

Etym.: in reference to the host on which the fungus was found.

Ascomata 250 µm diam, 210 µm alta, immersa, globosa vel subglobosa, ostiolata. Asci 100-125 x 10-12.5 µm, sine apparatu apicale. Ascosporae 14-16.5 x 5-6.5 µm, ellipsoideae, unilateraliter applanatae et attenuata praeditae, fissuro germen dispando praeditae.

Ascomata immersed, visible as blackened, slightly raised areas, mostly clustered or solitary (Fig. 9); in vertical section ca 250 µm diam, 210 µm high, globose to subglobose, brown, coriaceous, with a central periphysate ostiolar canal (Fig. 10). Clypeus black, ca 300 µm diam, 40 µm high, comprising host cells and blackened intracellular hypha (Fig. 10). Peridium ca 15 µm wide, comprising brown, thick-walled, compressed cells (Fig. 11). Paraphyses 2.5-4 µm ($\bar{x}$ = 3.4 µm, n = 10) wide at the base, filamentous, flexuose, septate and embedded in a gelatinous matrix. Asci 100-125 x 10-12.5 µm ($\bar{x}$ = 112 x 11.6 µm, n = 20), 8-spored, broadly cylindrical,



Figs 9-16. *Anthostomella scirpi* (from holotype). 9. Appearance of ascomata on the host surface. 10. Section of ascoma. Note the blackened clypeus. 11. Peridium. 12, 13. Asci. Note the lack of an apical apparatus. 14-16. Ascospores. Note germ slit straight (arrowed in 16). Scale bars: 9 = 1000 µm, 10 = 50 µm, 11-13 = 20 µm, 14-16 = 10 µm.

pedicellate, unitunicate, apically rounded and lacking an apical apparatus (Figs 12, 13). Ascospores 14-16.5 x 5-6.5 µm ($\overline{x}$ = 15.5 x 5.5 µm, n = 25), overlapping uniseriate or partially biseriate, ellipsoidal with one side flattened and ends tapering, brown, unicellular, smooth-walled, surrounded by a thin mucilaginous sheath, 1-1.5 µm ($\bar{x}$ = 1.1 µm, n = 10), germ slit straight, ventral, indistinct (Figs 14-16).

Holotype: Portugal, Estremadura, Praia das Macas Province, on culm of *Scirpus*, 14 Apr. 1965, M. R. S. Dias & M. T. Lucas 1891 (LISE 65661).

Anthostomella scirpi has similar sized ascospores and lacks an ascal apparatus as in *A. palmicola* (Auersw.) Rabenh., *A. melanotes* (Berk. & Broome) Martin, and *A. eructans* Ellis & Everh. *Anthostomella scirpi* differs from *A. palmicola* (Auersw.) Rabenh. and *A. melanotes* (Berk. & Broome) Martin as ascospores in *A. scirpi* are ellipsoidal with one side flattened and ends tapering, while those in *A. palmicola* and *A. melanotes* are ellipsoidal with ends rounded [Material examined: Italy, Sardinia, Alghero, on leaf of *Chamaerops humilis*, Jun 1866, Marcucci, *Unio Itin. Crypt.* no. 58 (S, W 358240, 371572, isotype of *Sordaria palmicola*); USA, South Dakota, Northville, on branches of *Symphoricarpus occidentalis*, May 1929, J. F. Brenckle distributed in: *Sydow, Fungi Exotici Exsiccati* no. 947 (NY, K 56357, W, isotype of *Anthostoma melanotes*)]. *Anthostomella scirpi* differs from *A. eructans* as ascospores in *A. scirpi* are ellipsoidal with one side flattened and ends tapering, while those in *A. eructans* are ellipsoidal and ends rounded. A addition, ascospores in *A. scirpi* are relatively longer (14-16.5 µm, $\bar{x}$ = 15.5 µm), while those in *A. eructans* are shorter (11.5-14 µm, $\bar{x}$ = 12.5 µm) [Material examined: USA, New York, Lyndonville, on decorticated branch, May 1889, C. E. Fairman 42 (NY, holotype of *A. eructans*)].

Discussion

Twenty-one species of *Anthostomella* are now known from Portugal, including new records and two new species. The first species of *Anthostomella* to be described from Portugal was *Anthostomella yuccae* Thüm., but this is now regarded as a synonym of *A. sphaeroidea* Speg. (Francis 1975). Fabre (1883) later added *A. scopariae* Fabre from *Erica* sp., which is a synonym of *Anthostomella delitescens* (De Not.) Sacc. (this paper). The further 19 species of *Anthostomella* known from Portugal and the present status of these species are given in Table 1 and the formal synonymies are given below.

Anthostomella clypeata (De Not.) Sacc., *Sylloge Fungorum* **1**: 283 (1882).

≡ *Sordaria clypeata* De Not., *Sferiacei italici* **1**: 24 (1863).
= *Anthostomella appendiculosa* (Berk. & Broome) Sacc. var. *lusitanica* Da Camara, *Agronomia Lusitana* **11**: 44 (1949).
= *Anthostomella clypeata* (De Not.) Sacc. f. *rubi-ulmifolii* Gonz. Frag., *Broteria,* series Botany, **21**: 131 (1924).

Material examined: Portugal, near Povoa Lanhoso, S. Gens, on stems of *Rubus ulmifolius*, Aug. 1924, G. Sampaio, ex herb. MA 7062 (IMI 183753, holotype of *A. clypeata* f. *rubi-ulmifolii*); Portugal, Algarve, Caldas de Monchique Province, on *Rubus* sp., 9 Mar. 1948, M. R. de Sounsa Dias 409 (LISE 23954, holotype of *A. appendiculosa* var. *lusitanica*); *ibid.* (IMI 195466, isotype of *A. appendiculosa* var *lusitanica*).

Anthostomella delitescens (De Not.) Sacc., *Michelia* **1**: 328 (1878).

≡ *Sphaeria delitescens* De Not., *Micromycetes Italiana Novi vel Minus Cogniti*, Decas **8**: 124 (1854).
= *Anthostomella lavandulae* T. Lucas & S. Dias., *Agronomia Lusitana* **16**: 82 (1954).
= *Anthostomella scopariae* Fabre, *Annales des Sciences Naturelles*, A. Botanique, series 6, **15**: 38 (1883).

Material examined: Italy, Genua, on *Erica arborea*, 9 Mar. 1842 (RO, holotype of *Sphaeria delitescens*); Portugal, on *Lavandula stoechas*, 20 May 1953, M. T. Lucas 1296 (LISE 38787, holotype of *A. lavandulae*); Portugal, Gallia, on *Erica scoparia*, H. Fabre (S, type of *A. scopariae*).

Acknowledgements

Bing-Sheng Lu would like to thank The University of Hong Kong for the award of a Postgraduate Studentship. We are grateful to Dr A. Aptroot for valuable comments on the manuscript. Dr Edward C. Y. Liew is thanked for commenting on the draft manuscript. Ms Helen Liew is thanked for technical assistance. Thanks are extended to the curators of herbaria IMI, K, LISE, NY, S and W for the loan of material examined in this study.

Table 1. *Anthostomella* species recorded in Portugal

Species	Portugal hosts	Conclusions	References
A. appendiculosa (Berk. & Broome) Sacc.	*Rubus* (Rosaceae); *Smilax* (Smilacaceae)	New record in Portugal	This paper
A. appendiculosa var. *lusitanica* Da Camara	*Rubia* (Rubiaceae)	A synonym of *A. clypeata* (De Not.) Sacc.	Da Camara 1949a; this paper
A. clypeata (De Not.) Sacc.	*Rosa* (Rosaceae); *Rubus* (Rosaceae)	New record in Portugal	This paper
A. clypeata f. *rubi-ulmifolii* Gonz. Frag.	*Rubus* (Rosaceae)	A synonym of *A. clypeata* (De Not.) Sacc.	This paper
A. clypeata var. *macrospora* Da Camara	*Rubus* (Rosaceae)	A species of *Clypeosphaeria*	Da Camara 1949b; Francis 1975; this paper
A. clypeatula Da Camara	*Jasminum* (Oleaceae)	A synonym of *A. tomicoides* Sacc.	Da Camara 1949b; Francis 1975
A. conorum (Fuckel) Sacc.	*Coronilla* (Leguminosae-Papilionoideae); *Mesembryanthemum* (Aizoaceae)	New record in Portugal	This paper

Species	Portugal hosts	Conclusions	References
A. consanguinea (Ces.) Sacc.	*Chamaerops* (Palmae)	New record in Portugal	This paper
A. constipata (Mont.) Sacc.	*Smilax* (Smilacaceae)	Portugal collections are species of *A. smilacis* (Auersw.) Fabre	This paper
A. cyperaceicola B. S. Lu & K. D. Hyde	*Scirpus* (Cyperaceae)	A new species	This paper
A. hypsophila Ellis & Everh.	*Lonicera* (Caprifoliaceae)	The type specimen of this species and the Portugal collections are species of *Amphisphaerella*	This paper
A. lavandulae T. Lucas & S. Dias	*Crataegus* (Rosaceae); *Lavandula* (Labiatae)	A synonym of *Anthostomella delitescens* (De Not.) Sacc.	Lucas & Da Camara 1954; this paper
A. olearum Sacc. & Speg.	*Olea* (Oleaceae)	The type material of this species and the Portugal collection are species of *Rosellinia*	This paper
A. palmacea (Cooke) Sacc.	Palm (Palmae)	It was transferred to *Didymosphaeria* by Francis and to *Montagnula* by Aptroot; The Portugal collections are *Anthostomella tenacis* (Cooke) Sacc	Francis 1975; Aptroot 1995; this paper

Species	Portugal hosts	Conclusions	References
A. phoenicicola Speg.	*Asparagus* (Asparagaceae); *Chamaerops* (Palmae); Palm (Palmae)	The Portugal collections are *Anthostomella tenacis* (Cooke) Sacc	This paper
A. pisana Pass.	*Chamaerops* (Palmae)	The Portugal collections are *Anthostomella tenacis* (Cooke) Sacc	This paper
A. scirpi B. S. Lu & K. D. Hyde	*Scirpus* (Cyperaceae)	A new species	This paper
A. scopariae Fabre	*Crataegus* (Rosaceae); *Erica* (Ericaceae)	A synonym of *Anthostomella delitescens* (De Not.) Sacc.	Fabre 1883; this paper
A. smilacis (Auersw.) Fabre	*Arecastrum* (Palmae); *Smilax* (Smilacaceae)	New record in Portugal	Francis 1975; this paper
A. punicae Lucas & Da Camara	*Punica* (Lythraceae)	A species of *Clypeosphaeria*	Lucas & Da Camara 1952; Francis 1975
A. yuccae Thüm.	*Cordyline* (Agavaceae); *Dasylirion* (Dracaenaceae); *Yucca* (Agavaceae)	A synonym of *A. sphaeroidea* Speg.	Francis 1975

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MYCOTAXON

Volume LXXIV(2), pp. 391-394 April-June 2000

A NEW SPECIES OF CANOMACULINA (LICHENIZED ASCOMYCOTINA, PARMELIACEAE) FROM ARGENTINA

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ABSTRACT : The species *Canomaculina laciniella* Ferraro & Elix is described as new to science. It is quite widely distributed on trees in northern Argentina.

South America appears to be the major centre of speciation of the parmelioid genus, *Canomaculina* Elix & Hale (= *Rimeliella* Kurok.) (Elix 1994, 1997). As a result of more recent studies on the regional species of Parmeliaceae (Ferraro 1979, Ferraro & Elix 1993), we are describing a further new species in this genus. Chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson & Amman 1979; Culberson *et al.* 1981; Culberson & Johnson 1982; Elix *et al.* 1989; Elix & Ernst-Russell 1993) and high performance liquid chromatography (Feige *et al.* 1993; Elix *et al.* 1997) and by comparison with authentic samples.

Canomaculina laciniella Ferraro & Elix, sp. nov. Figure 1

Differt a *Canomaculina uruguayensis* lobis laciniatibus, laciniis canaliculatibus et pagina inferiore nigra.

Type. Argentina. Corrientes Province. Depto. Monte Caseros, Timboy Stream along Route 122, 13 km W of Monte Caseros, on trees at the forest margin, *A. Schinini et al. 19705;* 10 Sept. 1979; CTES-holotype; US-isotype.

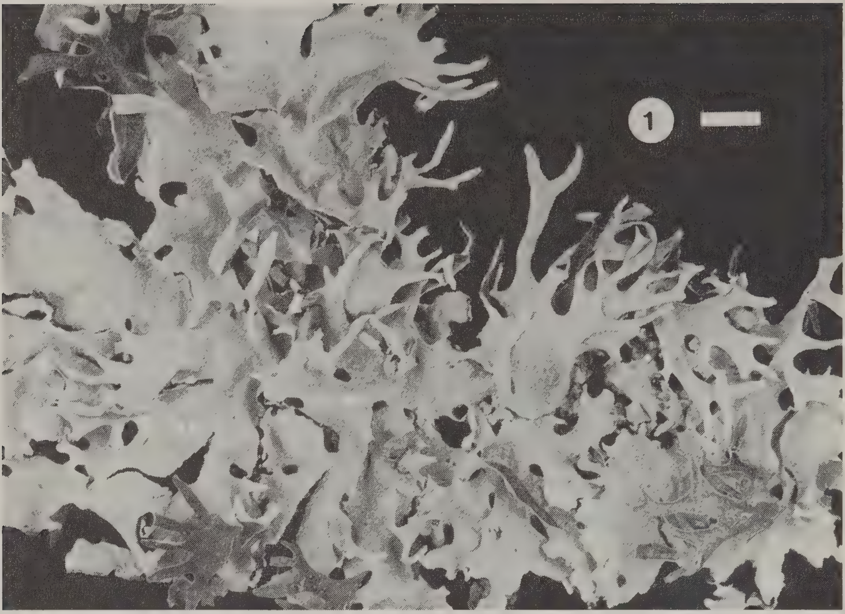

Figure 1. *Canomaculina laciniella* (holotype in CTES). Scale = 5 mm.

Thallus corticolous, loosely adnate, coriaceous, mineral grey, 4-10 cm wide. *Lobes* rotund, 3-10 mm wide, margins broadly crenate, ciliate, cilia abundant, very short, 0.2-0.5 mm long, rarely sparsely branched; lobes often becoming laciniate, laciniae 1.0-3.0 mm wide, 3-10 mm long, dichotomously to digitately branched, convex, lower surface canaliculate. *Upper surface* plane, shiny, strongly effigurate white-maculate, becoming cracked with age, lacking soredia and isidia. *Lower surface* black to the margins; rhizines dimorphous, short rhizinate or papillate to the margins, short rhizines simple to commonly branched and intertwined, dense, to 0.3 mm long, long rhizines sparse, coarse, simple or dichotomously branched, more than 1.0-2.0 mm long. *Apothecia* common, stipitate, 2-7 mm wide; disc perforate, thalline exciple smooth then rugulose, strongly white-maculate; spores 10-12 x 6-8 µm. *Pycnidia* common, conidia filiform, 10-14 x 1 µm.

Chemistry. Cortex K+ yellow; medulla K+ yellow turning red, C-, P+ orange; containing atranorin (minor), chloroatranorin (minor), salazinic acid (major), consalazinic acid (minor), protocetraric acid (trace), usnic acid (trace).

The following characters, present in this species, are characteristic of the genus *Canomaculina* Elix & Hale: effigurate-maculate upper surface, dimorphous rhizines, sparsely branched cilia and filiform conidia (Elix 1997; Kurokawa 1991). Morphologically *C. laciniella* resembles *C. uruguayensis* (Kremp.) Elix and *C. cristobalii* (Ferraro & Elix) Elix. Although *C. uruguayensis* has intricate short rhizines like *C. laciniella,* this species has a brown lower surface for the most part (only becoming black in the centre) and lacks laciniae. *Canomaculina laciniella* is clearly distinguished from *C. cristobalii* on the other hand, by the smaller spores (10-12 x 6-8 µm *cf.* 13-16 x 7-10 µm), the nature of the laciniae (flat in *C. cristobalii* - convex in *C. laciniella*) and medullary chemistry. Thus *C. laciniella* contains medullary salazinic and consalazinic acids whereas *C. cristobalii* contains additional loxodin and norlobaridone.

Specimens Examined

ARGENTINA. Corrientes Province. Depto. Gral. Paz, Lomas de Vallejos, *A. Schinini & C. Quarín 7834,* 29.viii.1973 (BG,CTES),*Schinini & C. Quarín 7856,* 29.viii.1973 (CTES, COLO, US). Depto. San Cosme, Puerto Gonzales, on twigs at forest margin, *L. Ferraro et al. 1845,* 21.v.1979 (CTES). Depto. San Luis del Palmar, Route 6, 16 km SE of San Luis del Palmar, in *Quebracho* forest, *C. L. Cristóbal 1689,* 24.x.1976 (CTES, COLO, US). Depto. San Martín, Arrocera Drews, 8 km N of Carlos Pellegrini, on *Quebracho* at margin of thick bush, *L. Ferraro & S. Tressens 799,* 16.ii.1976, *A. Krapovickas & C. L. Cristóbal 17.353,* 30.x.1971 (CTES, US). Depto. San Roque, Route 23 along left side of the Río Santa Lucía, *L. Ferraro et al. 2930,* 28.xii.1983 (CTES, US). Depto. Santa Tomé, Estancia Timbó, 28°21, 55°47'W, *A. Schinini 23349,* 2.ii.1983 (CTES).

ACKNOWLEDGEMENT

We thank Stuart Hay and Neal McCracken of the Photographic Unit, ANU, for preparing the photographs and Dr Alan Archer for helpful amendments to the draft manuscript.

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MYCOTAXON

Volume LXXIV(2), pp. 395-414 April-June 2000

MICROSCOPIC ASCOMYCETES ISOLATED FROM ROTTING WOOD IN THE BOREAL FOREST

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Abstract: During a survey of microfungi from rotting wood in northern Alberta forests, 49 species of ascomycetes, representing 24 genera, and 15 families in seven orders, were recovered. Twenty-eight species are new reports for Alberta, 15 of which are new for Canada, and seven are new for North America. Twenty species have not been reported previously from wood. The most frequently isolated species were *Microascus albonigrescens* and *Gelasinospora tetrasperma*. Diversity and abundance of ascomycete microfungi suggest that these fungi are a more significant component of wood decay fungus communities than previously recognized.

Keywords: biodiversity, decomposition, fungi, poplar, spruce, wood decay

Introduction

Woody material is a large reservoir of carbon in forest ecosystems, but relatively little is known about the communities of fungi that are responsible for the decomposition of this material. Most studies have concentrated on wood-decay basidiomycetes (e.g., Martin and Gilbertson 1978), or ascomycetes with superficial and macroscopic fruiting bodies (e.g., Abbott and Currah 1989), but the isolation of microscopic ascomycetes from wood has rarely been attempted. Studies of microfungi from wood have primarily reported hyphomycetes, and include only a few ascomycetes (e.g., Crawford et al. 1990; Duncan and Eslyn 1966).

During a survey of microfungi associated with decomposing wood in the boreal forest of Alberta, 298 fertile ascomycete cultures were recovered. Many of these are previously unknown from wood and some are known only from a few collections worldwide. It is our opinion that these hitherto overlooked organisms are not only playing an important role in the ecology of wood decay, but are important components of the biodiversity of boreal forest ecosystems. For these reasons, we provide an annotated list of ascomycetes recovered from rotting logs in undisturbed boreal forest of northern Alberta, as well as from logs of post-fire and post-harvest sites in the same region.

Materials and Methods

Study sites and sampling. Logs of diameter greater than 15 cm were sampled from undisturbed (1000 samples), post-fire (300 samples), and post-harvest (250 samples) sites in north-central and northeastern Alberta, Canada during the summers of 1995-1997. Most samples were taken from sites in Elk Island National Park (53°40'N, 112°48'W), Mariana Lakes area (56°16'N, 111°40'W), near Slave (55°35'N, 114°42'W) and Calling (55°26'N, 113°33W) Lakes, but some samples were taken from several other sites. Most samples were from white spruce (*Picea glauca*) and aspen (*Populus tremuloides*), but some were from other species (*Abies balsamea, Alnus tenuifolia, Betula papyrifera, Larix laricina, Picea mariana, Pinus banksiana, Populus balsamifera, Salix discolor*). Stage of decomposition was determined for each log. Gymnosperm logs were characterized according to Sollins (1982). Stage I logs were newly fallen and supported above the ground by branches; bark was intact. Stage II were losing small branches, but wood was hard. Stage III had lost most branches and bark and were in contact with the ground along the entire length; wood was soft. At stage IV, bark and branches were gone and the wood was broken into large chunks, and by stage V, wood was becoming humified and visible as a hummock on the forest floor. Angiosperm logs decompose more quickly and less uniformly, with fewer consistent external indicators. Consequently, only three decomposition stages were recognized: early stage (stage I) logs still had bark and branches attached, intermediate stage (stage II) logs were noticeably softer, and had most bark and branches gone, and late stage (stage III) logs were mostly humified and visible as hummocks.

Media and plating. Logs were sampled in one of two ways. Early stage logs, with wood intact, were sampled by cutting cross-sectional "cookies" with a bow-saw and extracting samples (approximately $1 cm^3$) using an ethanol-sterilized chisel. Late stage logs were sampled by extracting approximately $1 cm^3$ of wood at various depths in the log. All samples were briefly flamed, and plated onto six media to encourage the growth of a broad spectrum of fungi. Media used were: tapwater agar (TWA, 1.5% agar w:v, which served primarily as a moist chamber), cornmeal agar (CMA, Difco, a non-specific medium), malt extract agar (MEA, 1.5% agar and malt extract w:v, a non-specific medium with a relatively high content of easily-assimilated carbon), MEA with benomyl (2 mg/L, primarily for the selection of resistant ascomycetes, such as Microascales), MEA with Rose Bengal (to retard the growth of all fungi, thus preventing rapid overgrowth and allowing isolation of slow-growing fungi), and Mycobiotic agar (MB, Difco, contains 400 mg/L cycloheximide which inhibits most fungi with the exception of certain ascomycetes, including some Onygenales and Microascales). Tetracycline (100 mg/L) was added to all media to inhibit the growth of bacteria.

Isolation and identification. Primary isolation plates were incubated at room temperature (19-24ºC) and examined every 2-3 months, for 18-24 months. Species determinations were made either directly from primary isolation plates or from pure cultures grown on MEA, or on other diagnostic media, as required. Polyvinyl alcohol and lactofuchsin were used as mounting media (Sigler 1992). Ascospores were observed in squash mount preparations. Slide cultures used cereal agar (Sigler 1992). Representative isolates and specimens are maintained in the University of Alberta Microfungus Collection and Herbarium (UAMH).

Enzymatic abilities. Cellulolytic ability was determined for selected strains following the cellulose azure method of Smith (1977) using a basal salts medium. Molten basal salts medium (10 ml) was poured into 50 ml screw-cap test tubes and these were autoclaved for 12 minutes at 121°C. One millilitre of a molten 2% suspension (w:v) of cellulose azure (Difco) in basal salts medium was added to each of the cooled test tubes. Test tubes were inoculated with small ($1 mm^3$) cubes of agar taken from the perimeter of colonies on MEA, and incubated in the dark at room temperature for eight weeks.

Results

Twenty-four genera, 15 families, and seven orders are represented. Twenty-eight species are new records for Alberta, eight of these are new records for Canada, and seven for North America. Twenty species have not been reported previously from wood. Isolation numbers are summarized for the eight most common genera (Fig. 1).

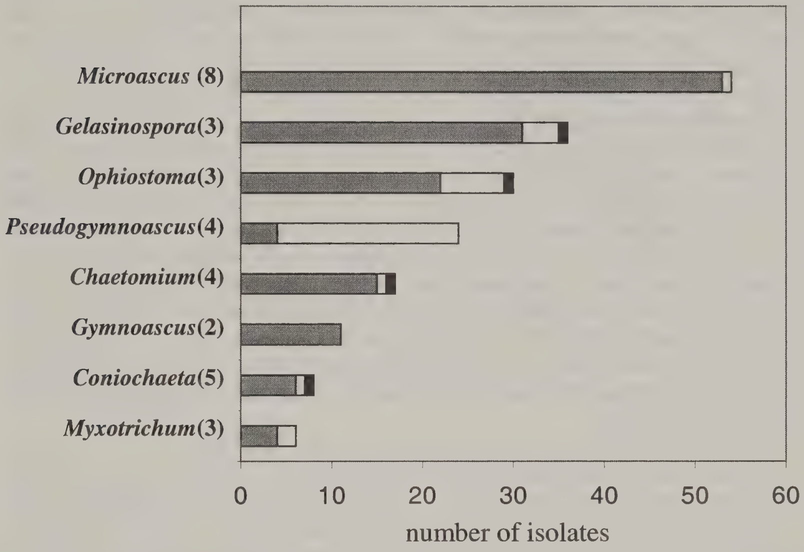

Figure 1. Number of isolates from the eight most common genera of ascomycetes isolated from rotting wood from undisturbed (gray), post-fire (white), and post-harvest (black) sites in the boreal forest of Alberta. Number of species is in parentheses.

Overall, *Microascus albonigrescens* was the most common (36 isolates), followed by *Gelasinospora tetrasperma* (32 isolates). *Pseudogymnoascus roseus* was also common (16 isolates) but was isolated almost exclusively from post-fire sites. Other examples of habitat specificity include *G. tetrasperma* almost exclusively from bark and *Gymnoascus uncinatus*, which was found only in Elk Island National Park. Only seven species were recovered from post-fire sites, including five from *Myxotrichaceae (Myxotrichum arcticum, Pseudogymnoascus alpinus, Pseudogymnoascus sp.*, *Pseudogymnoascus frigidus*, and *Pseudogymnoascus roseus*), and only four species were recovered from post-harvest sites (*Chaetomium funicola*, *Coniochaeta saccardoi*, *Gelasinospora tetrasperma*, and *Podospora tetraspora*).

Some species were strictly associated with one wood type. Twenty-one species were found only on gymnosperms and nine species were isolated exclusively from poplars. Species recovered from both log types were *Chaetomium funicola, Coniochaeta malacotricha, C. saccardoi, Emericella nidulans, Eupenicillium* *lapidosum, G. tetrasperma, Microascus* cf. *nidicola, M. singularis*, and *Ophiostoma piluliferum.*

Discussion

Overall, most isolates came from wood sampled in undisturbed sites, where most of the samples were taken. Species of *Gymnoascus* came only from the undisturbed site in Elk Island National Park, and all but one isolate of *Microascus* spp. also came from this site. There was evidence of a great deal of animal activity, especially by ungulates, whose dung may have contributed to the relatively large number of isolations of these fungi. Species of *Chaetomium*, *Coniochaeta*, *Ophiostoma*, and *Gelasinospora* were isolated from all site types, and *Pseudogymnoascus* and *Myxotrichum* spp. (Myxotrichaceae) were isolated from undisturbed and post-fire sites only.

Direct examination of logs, branches, and twigs for superficially fruiting ascomycetes has been the traditional method for wood surveys, but the ascomycete flora detected in this manner (e.g., Ellis and Ellis 1985) is quite different from those isolated from the interior of decayed logs by plating the wood directly. Soft-rot fungi, including many *Chaetomium* spp., are vigorously cellulolytic and prevalent in wood (Rayner and Boddy, 1988) but only observable after isolation. In addition to cellulose, other substrata are also available to microfungi in rotting wood. These include lignin, xylan, insect frass and carcasses, keratinous animal remains, and other residual proteinaceous material and organic compounds deposited by the action of other organisms. The diversity of additional substrates may help explain the diversity of ascomycete species that have not previously been reported from rotting wood. Some of these ascomycetes, while not strongly cellulolytic, are able to utilize other substrata and may be an integral part of the decay process.

The Microascaceae (teleomorphs and anamorphs) are commonly reported from urban and agricultural areas, and are reported only infrequently from nature, with even fewer reports from the boreal forest. Collections of this group come mainly from dung, litter, soil, or as airborne spores (e.g., Morton and Smith 1963; von Arx et al. 1988), but *Microascus* species were the most commonly isolated in this study, and the genus *Microascus* accounted for the greatest number of species (Fig. 1). Most microascaceous fungi are cellulolytic and proteolytic, and presumably their role in the communities of fungi on herbivore dung is the degradation of residual cellulose and proteins. Cellulose-rich woody debris on the forest floor has not been extensively sampled for these fungi. Cellulolytic abilities for five of the *Microascus* species recovered (*Microascus albonigrescens, M. longirostris, M. manginii, M.* cf. *nidicola, M. singularis*) were tested using cellulose azure and by cellophane membrane degradation (Abbott and Lumley unpublished results). All species were moderately or weakly cellulolytic: *M. albonigrescens* was best able to degrade cellulose, while *M. longirostris, M. manginii, M.* cf. *nidicola,* and *M. singularis* degraded cellulose only to a limited extent after prolonged incubation. Interestingly, *M. albonigrescens* was the most frequently isolated species of *Microascus* (36 isolates) and the other species of *Microascus* were comparatively rare (18 isolates in total). Many anamorphic taxa allied to the Microascaceae were also recovered from decayed wood, including species of *Scopulariopsis, Cephalotrichum* and *Wardomyces.*

Ophiostoma species and their anamorphs (e.g., *Leptographium* spp.) are a common cause of bluestain (Dowding 1970; Wingfield et al. 1993), and are frequently found associated with beetle galleries. These fungi are frequently isolated from lumber and logs, but very little is known about the ability of *Ophiostoma* species to compete with fungi during the latter stages of wood decomposition. Three species isolated produced perithecia in pure culture and, although anamorphic Ophiostomataceae were common during this study, teleomorphic strains were uncommon.

Chaetomium species are strongly cellulolytic, soft-rot fungi often isolated from soil (Gochenaur 1978), humus, litter, dung (Cain 1934), and wood (Duncan and Eslyn 1966). Many *Chaetomium* species are active at low water availability and their action can cause an accumulation of moisture. This is ecologically significant because it allows *Chaetomium* species to inhabit xeric environments where there is relatively little competition, but as water accumulates, they may be replaced by other, less xerotolerant, species. *Chaetomium* spp. were isolated from all site types and were among the few ascomycete species from post-harvest sites. These species were most frequent from early or intermediate stage logs, presumably correlated to low moisture levels.

The ecology of the Myxotrichaceae is virtually unknown, owing mainly to the inconspicuous nature of the ascomata and the relative difficulty with which they are cultured from natural substrata. Of the 16 accepted species, over half are known from three or fewer collections worldwide. Consequently, species distributions are uncertain and taxonomic circumscriptions at the species level are unreliable. Their ability to degrade cellulose is well-documented (Currah 1985) and, like *Microascus* species, were found to exhibit a broad range of cellulolytic abilities. *Pseudogymnoascus roseus* was the most efficient, followed by other *Pseudogymnoascus* species and *Myxotrichum arcticum*, which were only weakly cellulolytic, while isolates of *Myxotrichum ochraceum* and *Myxotrichum cancellatum* showed little or no cellulolytic ability. It is interesting that most isolates of *Pseudogymnoascus* spp. were recovered from post-fire sites, including from charred wood, although the reason for this is unknown.

Annotations

Species are listed alphabetically by genus and species with annotations concerning key diagnostic features and information on substrates and distribution. Annotations provide: Name and citation, taxonomic affiliation (Family, Order) following Eriksson and Hawksworth (1998), distinctive morphological features, taxonomic notes, substratum preference (stages I-V gymnosperm, stages I-III angiosperm) and any special adaptations (e.g., xerophily), and geographic distribution. "Collections examined" includes other specimens from Alberta and worldwide, including type material in some cases, used to confirm identity. Unless otherwise noted, material from Elk Island National Park, Mariana Lake, and Slave Lake was isolated by T. Lumley. To designate a taxon as a new record for Alberta, Canada, or North America, published works were searched, but herbarium records and unpublished lists were not.

Arthroderma curreyi Berkeley, 1860, Outlines of Brit. Fungology, p. 357.
(Arthrodermataceae, Onygenales)

Ascomata sterile; *Chrysosporium* anamorph distinguishes this species from other heterothallic *Arthroderma* species. Keratinolytic (Currah 1985), found on bark in one undisturbed site, possibly from bird activity (Pugh 1964). Widespread (e.g., Europe, Australia, USA). The specimen reported from Alberta in Currah (1985) proved to be *A. cuniculi.*

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* bark, III, IV (UAMH 8728). **USA: Ohio:** soil, Kurup 1968 (UAMH 3171). **AUSTRALIA:** Melbourne: ex human arm (UAMH 7903).

Byssochlamys* cf. *fulva Oliver and Smith, 1933, J. Bot. Lond. 72: 197.
(Trichocomaceae, Eurotiales)

Cleistothecia pallid; ascospores hyaline, refractive, 6 x 4 µm; *Paecilomyces* state abundant. Several isolates were recovered on primary isolation plates after one-year incubation, but pure cultures were not obtained. Conidium size differed from the type of *B. fulva* (3-4.5 x 2-3 µm in UAMH 9624 versus 4.5-9 x 1.5-3.5 µm in UAMH 3094), and from the range reported in Stolk and Samson (1971)(4-8.5 x 1.5-5 µm) .

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* II, 2-year post-fire site (UAMH 9624); *Picea glauca* III; Elk Island National Park: *Populus tremuloides* II decomposition. **UK:** bottled fruit, Rendle 1933 (ex-type of *B. fulva*)(UAMH 3094).

Chaetomium funicola Cooke, 1873, Grevillea 1: 176.
(Chaetomiaceae, Sordariales)

Perithecia with distinctive two-tiered hairs, the first short, dichotomously-branched hairs, the second long and straight; ascospores limoniform, more acute at one end, 5.5-6.5 x 3.5-5.0 µm. Separated from the similar *C. dolichotrichum* Ames, which has dichotomously-branched hairs, by the presence of a second tier (Domsch et al. 1980), and from *C. elatum* Kunze : Fries by the smaller ascospores (10-13 x 8-10 µm in *C. elatum*). A cellulolytic, soft-rot fungus (Duncan and Eslyn 1966), possibly xerophilic. Worldwide, reported from pine litter (Hayes 1965), timber and paper, and forest soil (Hammill 1970). First report for Alberta.

Material examined: CANADA: Alberta: Elk Island National Park: *Populus tremuloides* II (UAMH 9370), *Picea glauca* I, IV; Slave Lake: 15-year post-harvest site, *Populus tremuloides* II. **USA:** Benjamin RSA 1683 (UAMH 3034). **COSTA RICA:** La Selva, Heredia Prov.: ex roots of epiphytic orchid *Pleurothallis* sp., Richardson 1991 (UAMH 7194).

Chaetomium globosum Kunze: Fries, 1829, Syst. Mycol. 3: 226.
(Chaetomiaceae, Sordariales)

Perithecia with wavy lateral hairs and undulate to loosely coiled terminal hairs; ascospores limoniform, 8.5-11.0 x 7.0-9.0 µm. Our isolates are probably var. *ochraceoides* Dreyfuss, because of the small ascospores and olive-green ascomata, but the delimitation among the five described varieties is not sharp (Dreyfuss 1976). *C. globosum* is common worldwide on most cellulosic substrata, including forest soil and litter (Hayes 1965), and wood (Mangenot 1952). Ascospores can survive drying for more than ten years (Page 1951). Reported from Alberta (Abbott et al. 1995; Sigler et al. 1996)

Material examined: CANADA: Alberta: Mariana Lake: *Populus tremuloides* I; Grimshaw: indoor air from *Apis mellifera* (honeybee) overwintering facility, Abbott 1994 (UAMH 7773); Devonian Botanic Garden near Devon: canvas in butterfly chrysalis incubation chamber, Abbott 1993 (UAMH 7407); Edmonton: indoor air, Sigler 1989 (UAMH 7142).

Chaetomium homopilatum Omrik, 1953, Mycologia 47: 749.
(Chaetomiaceae, Sordariales)

Perithecia elongate (subcylindric to ampulliform) with lateral and terminal, straight, unbranched hairs; ascospores limoniform with strongly apiculate apices, bilaterally flattened, 8.5-10 x 4.5 µm; *Botryotrichum* state present. First report from Canada.

Material examined: CANADA: Alberta: Elk Island National Park: *Populus tremuloides* II (UAMH 9453). **COSTA RICA: Heredia:** La Selva, roots of epiphytic orchid (*Dryadella pusiola*) Richardson 1991 (UAMH 7196).

Chaetomium piluliferum Daniels, 1961, Trans. Brit. Mycol. Soc. 44: 84.
(Chaetomiaceae, Sordariales)

Perithecia with uncinate hairs; ascospores ellipsoid, 13-16 x 7-8 µm; *Botryotrichum* state of large, globose, hyaline conidia from a hyaline, racemosely-branched conidiophore. Ascomata typically sterile, but two isolates examined from Alberta (UAMH 1086, 1387) form fertile ascomata in culture. *C. murorum* and *C. piluliferoides* are similar, but have narrower ascospores (Domsch et al. 1980). *Chaetomium piluliferum* is often found on dung, but also in soil and, less commonly, on wood. Cellulolytic (Daniels 1961), chitinolytic (Okafor 1967), and ligninolytic (Haider and Domsch 1969). Reported from Alberta by Sigler et al. (1996).

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II, V, *Populus tremuloides* II (UAMH 9371); Mariana Lake: *Picea glauca* II; Grimshaw: indoor air from honeybee (*Apis mellifera*) overwintering facility, Abbott 1994 (UAMH 7718); Edmonton: lungs ex Richardson's ground squirrel (*Spermophilus richardsonii*), Carmichael 1962 (UAMH 1387); spleen of rodent, Carmichael 1960 (UAMH 1086); coyote (*Canis latrans*) dung, Currah (UAMH 5589).

Coniochaeta ellipsoidea Udagawa, 1967, Trans. Mycol. Soc. Japan 8: 51.
(Coniochaetaceae, Sordariales)

Perithecia sparsely setose; ascospores asymmetrical, 20-25 x 10-11.5 µm. A single strain of this species produced confluent ascomata on the primary isolation plate, but subsequent subcultures were not viable. Previously reported from soil in Japan and Spain (Udagawa and Takada 1967; Checa et al. 1988). First record for North America and from wood.

Material examined: CANADA: Alberta: Slave Lake: 30-year post-fire site *Picea glauca* III (UAMH 9502).

Coniochaeta ligniaria (Greville) Massee, 1887, Grevillea 16: 37.
(Coniochaetaceae, Sordariales)

Perithecia setose, black; ascospores discoidal, with longitudinal germ slit, 11-13 x 8.5-9.5 µm; *Lecythophora* anamorph. Reported from wood of *Alnus, Fagus, Pinus, Quercus, Ulex,* and *Ulmus*, including some from western Canada (Ellis and Ellis 1985; Ginns 1986).

Material examined: CANADA: Alberta: Rocky-Clearwater Forest: rotted *Populus* wood, Sigler 1986 (UAMH 5533).

Coniochaeta malacotricha (Auserwald) Traverso, 1907, Flora Italica Cryptogama 1: 473.
(Coniochaetaceae, Sordariales)

Perithecia setose, black; ascospores asymmetrical, broadly ellipsoid in face view, 10-12.5 x 5.5-7 µm; *Lecythophora* anamorph. Fertile ascomata abundant on cellophane membrane (Carmichael 1963). Previous reports only from conifer wood (Mahoney and LaFavre 1981; Rogers and Grand 1971), including *Pinus* in Ontario (Ginns 1986). First report on poplar; first reports for Alberta.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* II (UAMH 9375); Elk Island National Park: *Populus tremuloides* II; Slave Lake; *Picea glauca* III (UAMH 9503).

Coniochaeta saccardoi (Marchal) Cain, 1968, Bibl. Mycol. 9: 65.
(Coniochaetaceae, Sordariales)

Perithecia densely setose, black; ascospores narrowly ellipsoid, 13-17 x 6-8 µm. Typically dung or soil inhabiting (Mahoney and LaFavre 1981), known previously in the boreal forest from rabbit dung in Saskatchewan (Cain 1934) and from caribou dung in arctic Alaska (Kobayasi et al. 1969). First report from wood and first report for Alberta.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV, V; Mariana Lake: *Populus tremuloides* III (UAMH 9504, 9505).

***Coniochaeta* sp.**

(Coniochaetaceae, Sordariales)

Perithecia pyriform to ovoid, black, moderately setose; asci cylindric with 8 uniseriate ascospores; ascospores black, smooth, with longitudinal germ slit, lacking gelatinous sheath, 11.5-14 x 4.5-5.5 µm; *Lecythophora* anamorph with allantoid conidia. Overlaps with *C. saccardoi,* but distinguished by consistently smaller ascospores and darker colonies. Possibly a new taxon.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* I (UAMH 9506).

Cryptendoxyla hypophloia Malloch and Cain, 1970, Can. J. Bot. 48: 1816.

(Pseudeurotiaceae, Eurotiales)

Ascomata black, non-ostiolate, peridium "cephalothecoid" (Malloch and Cain 1970); asci evanescent, pyriform, short-stipitate, 8-spored; ascospores dark-brown, long-cylindrical, 4.5-5.5 x 2-3 µm; *Chalara* anamorph common in most isolates, rarely sparse. Species originally described beneath the bark of standing, dead ("snag") deciduous trees (Malloch and Cain 1970). Our isolate came from an aspen snag and is the first record from outside Ontario. Possibly arthropod dispersed (Malloch and Cain 1970).

Material examined: CANADA: Alberta: Elk Island National Park: standing (snag) *Populus tremuloides* (UAMH 9468). **Ontario:** Ottawa: nails of human male, 1995 (UAMH 8816); ex human hand, 1991 (UAMH 7049).

Emericella nidulans (Eidam) Vuillemin, 1927, Compt. Rend. Hebd. Séances Acad. Sci., Paris 184: 137.

(Trichocomaceae, Eurotiales)

Cleistothecia reddish, surrounded by a layer of yellow hülle cells; ascospores with two ribbed equatorial crests, or "flanges", 4-6 x 3-4 µm; *Aspergillus* state (*A. nidulans* (Eidam) Winter), conidiophores pigmented, with biseriate aspergilla and rough-walled, globose conidia. Distinguished from the similar *Emericella rugulosa* by smooth, convex ascospore walls, and rapid growth rate (Klich and Pitt 1988). *E. nidulans* is most frequently isolated from soil in warm regions (Domsch et al. 1980), but reports also include Canada and Alberta (Bisby et al. 1935; Sigler et al. 1996). Cellulolytic (Marsh et al. 1949; Reese and Downing 1951; Reese and Levinson 1952) and possibly ligninolytic (Bull and Carter 1973). First report from wood.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV; Wagner Natural Area near Spruce Grove: *Populus balsamifera* II, Abbott 1996 (UAMH 9373), rotted wood of willow *(Salix discolor*), Abbott 1996 (SA-M280); Grimshaw: indoor air from *Apis mellifera* (honeybee) overwintering facility, Abbott 1994 (UAMH 7677).

Eremomyces bilateralis Malloch and Cain, 1971, Can. J. Bot. 49: 849-850.

(Eremomycetaceae, Dothideales)

Cleistothecia globose, black; ascospores hyaline, plano-convex, 3.5-5.5 x 2-3.5 µm; anamorph lacking. Although ascomata and ascospores are reminiscent of Microascaceae, this species is readily distinguished by cleistothecia that split at maturity to release a hyaline spore mass, and by the pseudoparenchymatous ascoma initials. Found previously on herbivore dung in North America and Africa (Malloch and Cain

1971a; Malloch and Sigler 1988). Our isolates are the most northerly collections known and the first report for Alberta and from wood.

Material examined: CANADA: Alberta: Elk Island National Park: *Populus tremuloides*, III (UAMH 8972, 8973). **USA: California:** Crystal Spring Reservoir, San Mateo Co.: pack rat dung, Malloch 1969 (paratype) (UAMH 5516).

Eupenicillium lapidosum Scott and Stolk, 1967, Antonie Leeuwenhoek J. Microbiol. 33: 298.
(Trichocomaceae, Eurotiales)

Cleistothecia with large refractive peridial cells; ascospores echinate, with 2 prominent, thin, equatorial crests; 6-6.5 x 4-4.5 µm; *Penicillium* anamorph. Uncommon, but primarily from soil. First report for Alberta and from wood.

Material examined: CANADA: Alberta: Red Earth: *Populus tremuloides* III, *Picea glauca* III; Mariana Lake: *Picea glauca* V, *Populus tremuloides* III (UAMH 9493).

Eurotium chevalieri Mangin, 1901, Ann. Sci. Nat. Botan., Ser. 9, 10: 361.
(Trichocomaceae, Eurotiales)

Cleistothecia bright yellow, subglobose; ascospores smooth, with 2 distinct equatorial flanges, mostly 4.5 µm diameter; anamorph in the *Aspergillus glaucus* group. Xerophilic, previously reported mainly as an airborne contaminant from Alberta (Sigler et al. 1996). First report from wood.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* V; Fairview: indoor air from *Apis mellifera* (honeybee) overwintering facility, Abbott 1994 (UAMH 7682). **USA:** ex coffee beans, Thom 1916 (authentic strain of *Eurotium chevalieri*) (UAMH 6583).

Gelasinospora endodonta (Malloch and Cain) von Arx, 1973, Kon. Ned. Akad. van Weten. Amsterdam Ser. C 76: 290.
(Sordariaceae, Sordariales)

Perithecia pyriform, ascospores broadly ellipsoid, black, surface with small, conical pits, 18.5-22 x 14.5-17 µm. Reported from soil in Australia (Malloch and Cain 1971b as *Anixiella endodonta*). First report for North America and from wood.

Material examined: CANADA: Alberta: Slave Lake: 15-year post-fire site *Picea glauca* III (UAMH 9501).

Gelasinospora retispora Cain, 1950, Can. J. Res. 28: 573.
(Sordariaceae, Sordariales)

Perithecia pyriform, black; asci 8-spored; ascospores, ellipsoid to broadly ellipsoid, with large, angular pits, 28-32 x 14-16 µm. Known from soil, litter, seeds, apple twigs and *Nothofagus* wood (Cain 1950; Domsch et al. 1980). Our single collection matches the ex-type culture (UAMH 484), and is the first report from Alberta.

Material examined: CANADA: Alberta: Slave Lake: *Picea glauca* V (UAMH 9495). **NETHERLANDS:** seeds of *Beta vulgaris*, 23 Dec 1955 (ex-type of *Gelasinospora retispora*) (UAMH 484).

Gelasinospora tetrasperma Dowding, 1933, Can. J. Res. 9: 294.
(Sordariaceae, Sordariales)

Perithecia pyriform, black; asci 4-spored; ascospores ellipsoid, surface finely pitted, 23-27 x 13-16 µm. Common from herbivore dung, especially in North America (Cain 1950; Kobyasi et al. 1969). Homothallic or secondarily homothallic (Sanni 1982). A first report from Alberta, but common from wood, especially burn sites in this study. Also reported from *Vaccinium* in Quebec (Ginns 1986). Ascospores may germinate only after heating (Cain 1950). First report from wood.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* I-V, *Populus tremuloides* I- III, burned rotted (stage IV) wood of jack pine (*Pinus banksiana*) in 1-year-old fire site, Abbott 1996 (UAMH 9372); Elk Island National Park: *Picea glauca* IV, V. **Ontario:** Muskoka District: coniferous duff in mixed forest, Khan 1990 (UAMH 7729); from Cain to Keeping 1955 (authentic material) (UAMH 480).

Gymnoascus reessii Baranetzky, 1872, Botanische Zeitung 30:158.
(Gymnoascaceae, Onygenales)

Cleistothecia small, deep orange to dull rust, peridium of interwoven, modified hyphae with numerous bifurcate and trifurcate appendages; ascospores oblate, red-brown, smooth, 3.0-4.0 x 1.5-2.5 µm. *G. reessii* is common from soil (Wicklow and Wittingham 1974) and dung of herbivores (Currah 1985) and carnivores (Sigler and Flis, 1998). Neither keratinolytic nor cellulolytic. First report from wood.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV (UAMH 8531), V; Lost River Canyon: coyote (*Canis latrans*) dung, Sigler 1983 (UAMH 4809); Red Deer: leg scrapings ex human female, Brown 1981 (UAMH 4416). **USA: California:** Coolinga, Fresno Co.: soil, Orr (UAMH 3158).

Gymnoascus uncinatus Eidam, 1880, Cohn Beitr. Biol. Pfl. 3:292.
(Gymnoascaceae, Onygenales)

Cleistothecia yellow-brown when mature, with long, uncinate peridial appendages; ascospores oblate, scattered pits barely visible under oil immersion, 4.5-5.5 x 1.5-3 µm; anamorph resembles *Chrysosporium merdarium*, with large yellow, asperulate conidia. *G. uncinatus* previously known only from dung (Samson 1972). Weakly cellulolytic, reports of keratinolytic ability (Currah 1985; von Arx 1987) not corroborated here. Previously reported from rotting wood in Alberta (Lumley and Currah 1995).

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II, IV, V (UAMH 8530, 9421). **USA: California:** dung, Benjamin (ex-type of *Gymnoascus uncinatus*) (UAMH 3913).

Gymnostellatospora frigida Uchiyama, Kamiya, and Udagawa, 1995, Mycoscience 36: 214.
(Myxotrichaceae, Onygenales)

Cleistothecia orange-brown, peridium of thin-walled, little-differentiated hyphae; ascospores with coarse, longitudinal ridges, some of which appear sigmoid under oil immersion, 4-5 x 3-4 µm. Type based on one isolate from forest soil in Japan (Uchiyama et al. 1995b). Differentiated from *Pseudogymnoascus japonicus*, which has ascospores with a more distinct sigmoid crest, and by the olive-green ascomata in *P. japonicus.* First report for North America and the first from wood.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* V (UAMH 9239), 2-year post-fire site, *Picea glauca* V (UAMH 9240).

Kernia retardata Udagawa and Muroi, 1981, Trans. Mycol. Soc. Japan 22: 18.
(Microascaceae, Microascales)

Cleistothecia black, globose; asci evanescent; ascospores ellipsoid, light red-brown, with a single germ pore, 6-8 x 4.5-5.5 µm; *Scopulariopsis* anamorph. Isolates from well rotted spruce wood were morphologically consistent with three other isolates from Alberta collected on decomposing leaves and dung. Many produced cleistothecia only on natural substrata and primary isolation plates, but also produced conidia sparsely in pure culture. Ascospore size varies more than described for the type specimen, both within and among collections. Previously known only from the type from soil in Japan (Udagawa and Muroi 1981). First report for North America and from wood.

Material examined: CANADA: Alberta: Slave Lake: *Picea glauca* III, 30 year post-fire site (UAMH 9500); Elk Island National Park: *Picea glauca* IV, V (UAMH 9420, 9454), leaf litter under *Corylus cornuta* and *Populus tremuloides,* Abbott 1997 (UAMH 9455); Devonian Botanic Garden near Devon: leaves of aspen (*Populus tremuloides*) on lawn with snow mold, Abbott 1997 (UAMH 9026); south of Leduc: dung of skunk (*Mephitis mephitis*) on ground in farm yard, Abbott 1997 (UAMH 9027). **JAPAN:** Nishinasuno-machi, Nasu-gun, Tochigi: rice (*Oryza sativa*) field soil, Muroi 1978 (ex-type of *Kernia retardata*) (UAMH 9134).

Leptosphaerulina argentinensis (Spegazzini) Graham and Luttrell, 1961, Phytopathol. 51: 687.

(Pleosporaceae, Dothideales)

Pseudothecia black; ascospores muriform, typically with 5 longitudinal and 3 transverse septa, 34 x 12.5 µm. Known mainly as a leaf saprophyte. First report from rotting wood. Our isolates are the only reports for Canada, and are the most northerly collections known.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV (UAMH 9507); Edmonton: soil under coniferous tree, Carmichael 1962 (UAMH 1333).

Microascus albonigrescens (Sopp) Curzi, 1931, Boll. Staz. Patol. Veg. Roma 11: 60.

(Microascaceae, Microascales)

Ascocarps black, papillate to short-necked, ostiolate; asci evanescent; ascospores allantoid-reniform (concavo-convex), 4.5-5 x 3-3.5 µm, orange in mass, cirrhi especially well developed as medium dehydrates; *Scopulariopsis* anamorph, conidia narrowly ellipsoid or narrow ovoidal, with a truncate base, white in mass, abundant in some isolates. Originally described from Scandinavia (Sopp 1912), and reported from North America by Barron et al. (1961a). It has also been isolated from wood in Sweden (CBS catalogue) and litter in Japan (UAMH 8851). The most frequently isolated ascomycete during this study. Abundant in well-decayed conifer wood. First reports from Canada. Unlike other species of *Microascus,* which are common on dung and in soil, this species is found primarily on wood and litter.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II, IV, V (UAMH 8487, 8490, 9148), *Populus tremuloides* III; Slave Lake: 15-year post- fire site: *Populus tremuloides* III (UAMH 9529); North Buck Lake near Lac La Biche: debris of red squirrel (*Tamiasciurus hudsonicus*) midden under jack pine (*Pinus banksiana*), Abbott 1996 (UAMH 8753). **USA: Massachusetts:** R. Thaxter, Harvard University (UAMH 9322). **JAPAN:** litter, K. Tubaki 1968 (UAMH 8851).

Microascus brevicaulis S.P. Abbott, 1998, Mycologia 90: 298.

(Microascaceae, Microascales)

Perithecia subglobose, papillate, black; asci evanescent, ascospores broadly reniform, 5-6 x 3.5-4.5 µm; *Scopulariopsis brevicaulis* anamorph (Abbott et al. 1998). All fertile isolates described have come from Alberta. A single ascocarpic isolate came from well decayed spruce wood, but many anamorphic strains from rotted white spruce wood (UAMH 9145), burned wood of *Picea mariana* (UAMH 8628), aspen twigs (UAMH 9253), soil, litter, and dung in the boreal forest (e.g., UAMH 8746-8751) were collected.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* V (UAMH 9387); Scandia: indoor air from *Apis mellifera* (honeybee) overwintering facility, Abbott 1994 (holotype of *Microascus brevicaulis*) (UAMH 7770); Calgary: indoor air of basement of home, Abbott 1995 (UAMH 7880); Edmonton: straw ex birdhouse roosts, Carmichael 1961 (UAMH 1197); Barrhead: outside air ex RCS strip, Abbott 1996 (UAMH 8627); Lethbridge: dead housefly larva, Bell (UAMH 3753).

Microascus cinereus (Emile-Weil and Gaudin) Curzi, 1931, Boll. Staz. Patol. Veg. Roma 11: 60.
(Microascaceae, Microascales)

Perithecia papillate to short-necked; asci evanescent; ascospores narrowly reniform, typically 5.5 x 3 µm, orange in mass, forming a long cirrhus at maturity; dematiaceous *Scopulariopsis* anamorph. Widespread and common in soil and on dung, and from clinical sources (Barron et al. 1961a; Morton and Smith 1963). First reports for Canada and the first from wood.

Material examined: CANADA: Alberta: Muskeg Road SW of Boyle: wood from dead branches of *Salix discolor* II, Abbott 1996 (UAMH 9486); Maqua Lake near Fort McMurray: dung of grouse under black spruce (*Picea mariana*), Abbott 1996 (UAMH 9366); Edmonton: toe nail, 1993 (UAMH 8681). **USA: California:** lung of man, Orr (UAMH 9390). **England:** soil, Mendy 1958 (UAMH 8889).

Microascus longirostris Zukal, 1885, Verh. Zool.-Bot. Ges. Wien 35: 339.
(Microascaceae, Microascales)

Perithecia black, neck long; asci evanescent; ascospores reniform, 3-4 x 2.5 µm, orange in mass and forming a cirrhus. The type and most commonly reported species of *Microascus*. Originally from dung and wood in contact with dung (Barron et al. 1961a), it has been isolated from seeds, plant remains, and a wasp nest (Barron et al. 1961a; Morton and Smith 1963). A single isolate made from wood in this study.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* V, *Populus tremuloides* III (UAMH 9151); Slave Lake: dung of coyote (*Canis latrans*), Sigler 1983 (UAMH 4833); north of Lac La Biche: lung of northern flying squirrel (*Glaucomys sabrina*), Csotonyi 1997 (UAMH 9042). **Saskatchewan:** Prince Albert: indoor air of mill woodroom, Abbott 1995 (UAMH 8354). **USA: Maine:** Kittery Point: wasp nest, Harvard University (UAMH 9329).

Microascus manginii (Loubière) Curzi, 1931, Boll. Staz. Patol. Veg. Roma 11: 60.
(Microascaceae, Microascales)

Perithecia black, papillate; asci evanescent; ascospores broadly reniform, 4-6 x 5 µm, orange in mass; *Scopulariopsis candida* anamorph is often the only state present. Perithecia in some isolates (e.g., UAMH 9174) sterile, a feature common in isolates of *S. candida* (Abbott et al. 1998). Fertile isolates not previously reported from wood, although *Scopulariopsis candida* was isolated from a wooden cheese barrel (Morton and Smith 1963).

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II (UAMH 9147, 9174), IV; Red Deer: outside air, Abbott 1995 (UAMH 7921). **USA: Arizona:** dung, Orr 1958 (UAMH 8977). **FRANCE:** Mangin, (ex-type of *Microascus manginii*) (UAMH 9135). **UK:** buckwheat chaff, Donnelly 1974 (UAMH 8797).

Microascus* cf. *nidicola Massee and Salmon, 1901, Ann. Bot. 15: 313-357.
(Microascaceae, Microascales)

Perithecia black, papillate; asci evanescent; ascospores narrow falcate-reniform, 7-8 x 2 µm, cirrhi inconspicuous or absent; *Scopulariopsis* anamorph. Ascospores consistent with the extralimital specimens, but colonial morphology and the *Scopulariopsis* anamorph are unique. Few reports since the original collection on dung (Massee and Salmon 1901). Barron et al. (1961a), Morton and Smith (1963), and von Arx et al. (1988) base their descriptions on material from desert regions of the USA (UAMH 8979, 8980). Only a few of our isolates produce fertile ascocarps (e.g., UAMH 9169), but several others produce sterile sclerotium-like structures (e.g., UAMH 9168) (see notes under *Microascus manginii*)(Abbott et al. 1998).

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II (UAMH 9167, 9168), *Populus tremuloides* III (UAMH 9169). **USA: Utah:** kangaroo rat (*Dipodomys merriami*), Emmons Oct 1956 (UAMH 8979), soil, Emmons Oct 1956 (UAMH 8980).

Microascus singularis (Saccardo) Malloch and Cain, 1971, Can. J. Bot. 49: 859.
(Microascaceae, Microascales)

Perithecia black, often covered with flexuous hairs, short-necked; asci evanescent; ascospores broadly reniform to heart-shaped, 3-4.5 x 2-3 µm, orange in mass; anamorph *Wardomycopsis,* conidia dark brown, ellipsoid, truncate at base, with germ slit, conidiophores compact and branched. The conidial state is the most prominent feature in some isolates, but sparsely produced in others. Ascomata mature slowly (8 weeks to 6 months) and are sparse in most isolates. Widely distributed, but infrequent. First reports for Canada.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* II (UAMH 8618, 9152), *Populus tremuloides* III (UAMH 9175). **USA: Massachusetts:** Cambridge: barrel bottom, Thaxter 1904 (UAMH 2637). **JAPAN:** Tokyo: laboratory contaminant, Udagawa 1962 (UAMH 9330).

Myxotrichum arcticum Udagawa, Uchiyama and Kamiya, 1994, Mycotaxon 52: 197-205.
(Myxotrichaceae, Onygenales)

Cleistothecia black with short, curved appendages; ascospores fusiform, with longitudinal ridges, 4-6 x 1.5-2.0 µm; *Oidiodendron* anamorph, some parts of conidiophores geniculate, giving rise to short, fertile branches which develop into conidia that appear blastic, otherwise resembling *Oidiodendron griseum.* The peridial cells resemble *Myxotrichum bicolor.* This is the second report of this species, and the first report for Canada and from wood.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* III (UAMH 9243), 2-year post-fire site, *Picea glauca* III (UAMH 9244); Slave Lake: 29-year post-fire site, *Picea glauca* V (UAMH 9337). **USA: Alaska:** Willow north of Wasilla: forest soil, Udagawa 1992 (ex-type of *Myxotrichum arcticum*) (UAMH 7565).

Myxotrichum cancellatum Phillips, 1884, Grevillea 13: 51.
(Myxotrichaceae, Onygenales)

Cleistothecia black, confluent in a dense mat, appendages long and spine-like; ascospores fusiform, smooth, 3-4 x 1-2 µm; anamorph reported as an *Oidiodendron*-state (Orr and Kuehn 1964a), our isolate *Geomyces*-like. Ascomata larger than type (200-500 µm vs. 100-250 µm), and appendages longer (100-500 µm vs. 50-300 µm). *M. cancellatum* has been found on dead *Fraxinus* branches, frozen blueberry pastries, a pineapple pericarp stored at 5°C, and soil (Orr and Kuehn 1964). The first isolation in Canada, and the first from wood. Enzymatic abilities unknown; our cellulose assay was negative.

Material examined: CANADA: British Columbia: near Mount Robson: well-rotted conifer wood under orchid (*Calypso bulbosa*), Lumley 1996 (UAMH 8727). **USA: New Jersey:** Camden: frozen blueberry pastry, Kuehn 1961 (UAMH 1911). **JAPAN:** Tokyo: soil, Udagawa 1959 (UAMH 1996).

Myxotrichum ochraceum Berkeley and Broome, 1875, Ann. Nat. Hist. IV. 15: 37.
(Myxotrichaceae, Onygenales)

Cleistothecia black, interspersed among bright yellow mycelium, peridial appendages long (up to 150 µm) and straight, with reflexed branching in the lower half; ascospores fusiform, with longitudinal ridges, 3.5-5 x 1.5-3 µm; *Malbranchea*-like anamorph. Differed in several respects from the type: appendages occurring at one level (vs. two,

Apinis 1964; Currah 1985) and pale yellow centrum (vs. bright orange-yellow, Apinis 1964). *M. ochraceum* has been isolated from wood shavings, twine and straw (Orr et al. 1963), rotten wood, bark, and cardboard (Currah 1985). *Myxotrichum ochraceum* var. *frigidum*, from forest soil in Japan, grows better at 15ºC (Uchiyama et al. 1995a).
Material examined: CANADA: Alberta: Elk Island National Park: *Populus tremuloides* II (UAMH 8532). **ENGLAND:** rotten cardboard (UAMH 1904).

Ophiostoma piliferum (Fries) H. and P. Sydow, 1919, Ann. Mycol. 17: 43.
(Ophiostomataceae, Ophiostomatales)
Perithecia black, long-necked, ostiolate; asci evanescent; ascospores hyaline, allantoid to falcate (concavo-convex), 3-4.5 x 1.5-2 μm; *Sporothrix* anamorph (see Benade et al. 1998). Widely distributed in North America; including from aspen wood in Alberta and British Columbia (UAMH 7233, 7459) and white spruce in Manitoba (Olchowecki and Reid 1974). Frequent on *Pinus,* but also on *Abies, Betula, Picea, Populus, Quercus, Thuja, Liquidambar* and *Platanus* (Olchowecki and Reid 1974; Ginns 1986; Griffin 1968; Upadhyay 1981, as *Ceratocystis pilifera*).
Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* II (UAMH 9374); Whitecourt: *Populus tremuloides* wood, Crane 1989 (UAMH 7233). **British Columbia:** Fort Nelson: *Populus tremuloides* wood, Hutchison 1991 (UAMH 7459).

Ophiostoma stenoceras (Robak) C. Moreau, 1952, Rev. Mycol. (Paris) Suppl. Colon. 17: 22.
(Ophiostomataceae, Ophiostomatales)
Perithecia black, long-necked, ostiolar hairs pointed and divergent; ascospores hyaline, reniform or orange-section shaped, concavo-convex, 2-4 x 1-1.5 μm, forming a droplet at ostiole; *Sporothrix* anamorph (see Upadhyay 1981). Perithecia abundantly produced on OAT. Widely distributed in North America, reported from *Pinus* and *Picea* in Ontario (Ginns 1986 as *Ceratocystis stenoceras*) and from air in Alberta (Sigler et al. 1996).
Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* I (UAMH 9530); St. Lina: indoor air of honeybee (*Apis mellifera*) overwintering facility, Abbott 1995 (UAMH 7953). **British Columbia:** Lynn Creek Road: bark of *Pinus contorta* attacked by *Dendroctonus* beetles, Sigler 1982 (UAMH 4590).

***Ophiostoma* sp.**
(Ophiostomataceae, Ophiostomatales)
Perithecia black, long-necked, ostiolar hairs pointed and divergent; ascospores ellipsoid, 2 x 1.5 μm, forming a clear droplet at the ostiole; synanamorphs *Sporothrix,* conidia 3.5-4 x 1.5 μm, consistent in all collections, and *Leptographium,* conidiophores 45-65 x 3 μm, conidia 3 x 1.5 μm. Slow growing, fertile perithecia forming on primary isolation plates after 1 year, but not in axenic culture. This was the most abundant *Ophiostoma* species and was found exclusively on intermediate to late stage decay spruce logs in undisturbed sites.
Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* III, V (UAMH 9531); Mariana Lake : *Picea glauca* II, III, IV.

Petriella sordida (Zukal) Barron and Gilman, 1961, Can. J. Bot. 39: 839.
(Microascaceae, Microascales)
Perithecia black, subglobose with distinct neck; asci evanescent; ascospores red-brown, asymmetrically ellipsoid to fusoid (plano-convex), smooth, 9-10 x 5 μm; synanamorphs

Graphium and *Scedosporium.* Known from soil, plant debris, and dung (Barron et al. 1961b). First report for Alberta.

Material examined: CANADA: Alberta: Wizard Lake near Calmar: wood of *Populus* II, Abbott 1997 (UAMH). **Nova Scotia:** Kentville: twigs of apple (*Malus* sp.) wood, Gourley (UAMH 8695). **Ontario:** Algonquin Provincial Park: porcupine (*Erythizon dorsatum*) dung, Scott 1991 (UAMH 7493). **ITALY:** dry branch of pear (*Pyrus communis*), Curzi (ex-type of *Petriella asymmetrica*)(UAMH 3983); Cyprus: bark of poplar (*Populus nigra*), Nattrass (ex-type of *Petriella asymmetrica* var. *cypria*)(UAMH 8893).

Podospora tetraspora (Winter) Cain, 1962, Can. J. Bot. 40: 460.
(Sordariaceae, Sordariales)

Perithecia with small tufts of agglutinated hairs; asci 4-spored; ascospores black, ellipsoid, with cylindrical apical appendage, approximately 10 µm long. Typically found on dung (Mirza and Cain 1969), not previously reported from rotting wood. Widespread, known from Ontario and Quebec (Mirza and Cain 1969) and Alaska (Kobayasi et al. 1969). First report for Alberta.

Material examined: CANADA: Alberta: Calling Lake: *Populus tremuloides* I (UAMH 9496), 15-year post-harvest site.

Pseudogymnoascus alpinus Müller and von Arx, 1982, Sydowia 35: 135.
(Myxotrichaceae, Onygenales)

Cleistothecia often confluent, white or bright yellow, without distinct peridial hyphae; ascospores fusoid, with a longitudinal ridge or ridges, 3-5 x 3-4 µm. Previously known only from the type, from the rhizosphere of *Erica carnea* (Müller and von Arx 1982). Our isolates differ from the type in having large, yellow ascomata, while those of the type are small and white or brownish. First report for North America and from wood.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* III (UAMH 9242), V (UAMH 9241). **SWITZERLAND:** Graubünden: rhizosphere of *Erica carnea,* Müller 1978 (UAMH 9430) (ex-type of *P. alpinus*).

***Pseudogymnoascus* sp.**
(Myxotrichaceae, Onygenales)

Cleistothecia yellow when young, olive-green when mature, with thin-walled, asperulate, clavate appendages; ascospores fusoid, with a longitudinal, sigmoid crest, 4-5 x 3-4 µm; *Ovadendron*-like anamorph resembles the *Geomyces* anamorph of *Pseudogymnoascus roseus* and the arthroconidial anamorph of *Pseudogymnoascus dendroideus* Locquin-Linard. Probably a new species. Weakly cellulolytic.

Material examined: CANADA: Alberta: Mariana Lake: *Picea glauca* V (UAMH 9238), 25-year post-fire site, *Picea glauca* III with some charring (UAMH 8899).

Pseudogymnoascus roseus Raillo, 1929, Zentralbl. Bakteriol. Parasitenkde Infektionskr Abt. 1 78:515.
(Myxotrichaceae, Onygenales)

Cleistothecia red-brown, peridium of loosely interwoven, thick-walled hyphae, appendages short (up to 20 µm long), straight, thin-walled, and asperulate; ascospores fusoid, smooth, 3-4.5 x 2-2.5 µm; *Geomyces* anamorph. *Geomyces* state and red-brown ascomata set this species apart from others in the genus. Worldwide distribution (Domsch et al. 1980). Isolated mainly from soil, including alpine and boreal forest soil in Alberta (Bissett and Parkinson 1979), forest and grassland soil (Morrall and Vanterpool 1968; Samson 1972; Orr 1979), and wood (Currah 1985). Most frequent from wood in post-fire sites. Vigorously cellulolytic.

Material examined: CANADA: Alberta: Mariana Lake: *Populus tremuloides* III, 30-year post-fire site, *Picea glauca* V (UAMH 9222); F951-03, F953-02, 2-year post-fire site *Picea glauca* V, 2-year post-fire site *Populus tremuloides* III; Slave Lake: 15-year post-fire site *Populus tremuloides* III; Gregoire Lake Provincial Park: soil, aspen (*Populus tremuloides*) forest under alder (*Alnus crispa*), Abbott 1996 (UAMH 8835); Kananaskis: soil under *Pinus contorta*, Widden 1967 (UAMH 2879); Cadomin: mycorrhizal roots of *Abies lasiocarpa*, Fernando (UAMH 9163). **Saskatchewan**: Grasslands National Park: bottom layer of ungrazed grassland soil, Abbott 1996 (UAMH 8834); Morrall (UAMH 3002). **ITALY:** Torino: wood of larch (*Larix decidua*), Dal Vesco (UAMH 1644).

Rosellinia aquila (Fries) de Notaris, 1844, Giorn. Bot. Ital. 1: 334.
(Xylariaceae, Xylariales)

Perithecia black, papillate, discrete and subglobose; ascospores inequilateral-ellipsoid to bean-shaped, with germ slit and small, hyaline appendages at the apices, 17-20 x 7-8 µm; *Geniculosporium* anamorph. Common on angiosperm wood (Ellis and Ellis 1988). Widely distributed (Dennis 1977; Martin 1967; Dargan and Thind 1979). First report for Canada.

Material examined: CANADA: Alberta: Sherwood Natural Area near Sherwood Park: standing *Populus tremuloides*, II, Abbott 1996 (UAMH 9465); **USA: New York:** Nyack Village, Rockland Co.: Martin 1963 (UAMH 1832). **MEXICO:** San Cristobal, Chiapes: cow dung, Martin 1962 (UAMH 2164).

Sordaria fimicola (Roberge) Cesati and De Notaris, 1863, Comm. Soc. Crit. Ital. 1: 226.
(Sordariaceae, Sordariales)

Perithecia pyriform, black; ascospores ellipsoid, smooth, black, with a narrow gelatinous sheath and a single prominent germ pore, 23-25 x 11-15 µm. Previously isolated from dung, herbaceous plants and seeds in Canada (Cain 1934; Cain and Groves 1948; Ginns 1986). Our isolates are the first known from wood and the first reports for Alberta.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* V (UAMH 9497); Lesser Slave Lake: carnivore dung, Sigler 1982 (UAMH 4575); Perryvale: living sphagnum moss (*Sphagnum fuscum*), Thormann 1997 (UAMH 9475).

Sphaerodes fimicola (Hansen) D. Hawksworth, 1982, Bot. J. Linn. Soc. 84: 146.
(Melanosporaceae, Sordariales)

Perithecia pyriform, with a translucent peridium; ascospores dark, limoniform, reticulate, 16-18 x 11-14 µm. Typically coprophilous, this is the first report from rotted wood and the first reports for Alberta.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV (UAMH 9369); ex roots of orchid (*Platanthera hyperborea*), Zelmer 1994 (UAMH 7777).

Strattonia carbonaria (Phillips and Plowright) Lundquist, 1972, Symb. Bot. Upsal. 20: 269.
(Lasiosphaeriaceae, Sordariales)

Perithecia ovoid; ascospores with a hyaline, triangular, apical appendage and appearing two-celled, 18-23 x 9-10 µm. It is generally found on burnt ground or charcoal (Dennis 1977; Ellis and Ellis 1988), and was found only once from a post-fire site in the boreal forest. First report for North America.

Material examined: CANADA: Alberta: F681-03, *Picea glauca* V, 30-year post-fire site (UAMH 9498).

Talaromyces retardatus Udagawa, Kamiya, and Osada, 1993, Trans. Mycol. Soc. Japan 34: 9.
(Trichocomaceae, Eurotiales)

Cleistothecia yellow to pink; ascospores ellipsoid, covered with blunt warts, pallid yellowish, 3.5-4.5 x 2.5-3 µm; *Penicillium* subgenus *Biverticillium* anamorph, well developed biverticillate conidiophores up to 300 µm long, conidia smooth to finely roughened, 3 x 2 µm; mycelium white to yellow, slow growing (8 mm in 7 days), producing a red diffusing pigment. Isolates produced ascomata after one year on primary isolation plates. These isolates faster growing than the ex-type culture (Udagawa et al. 1993), but slower than other species in *Talaromyces* section *Lutei* (Pitt 1979). Type material from decaying wood in Japan (Udagawa et al. 1993). First report for North America.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV, V (UAMH 9494); Mariana Lake: *Picea glauca* III.

Talaromyces udagawae Stolk and Samson, 1972, Stud. Mycol. 2: 36.
(Trichocomaceae, Eurotiales)

Cleistothecia large (often over 1 mm on MEA after 6 months), bright yellow, peridium of loosely-interwoven, occasionally encrusted hyphae, including some radiating elements; ascospores with distinct lateral or spiral bands or crests, 3-4.5 x 2-3 µm; biverticillate *Penicillium* anamorph often sparse. Similar to *Talaromyces luteus* (Zukal) C.R. Benjamin, considered distinct by Stolk and Samson (1972) on the basis of larger ascospores and spiral ornamentation. *T. udagawae* was previously known only from the type, from soil, Misugimura, Japan. First report for North America and from wood.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* V (UAMH 9338).

Thielavia terrestris (Apinis) Malloch and Cain, 1972, Can. J. Bot. 50: 61.
(Chaetomiaceae, Sordariales)

Perithecia black, non-ostiolate, smooth or with hypha-like setoid appendages, 100-200 µm diameter; ascospores ovoid, dark brown, 4-6 x 3-4 µm; *Acremonium* anamorph, conidia borne in short chains or in slimy heads. Heterothallic; most isolates produce only the conidial state and sterile ascomata in culture. Previously isolated from soil and plant debris, including wood (von Arx 1975; Wacha and Tiffany 1979). First report for Alberta.

Material examined: CANADA: Alberta: Elk Island National Park: *Picea glauca* IV, V, *Populus tremuloides* III (UAMH 8975); Edmonton: soil by hair bait, Blondell-Hill 1990 (UAMH 6818); human toe nail, Sand 1995 (UAMH 8112). **British Columbia:** Vancouver: spruce and pine wood, Forest Products Lab (UAMH 3264-3268). **ENGLAND:** pasture soil, Apinis (ex-type of *Allescheria terrestris*)(UAMH 3988).

Acknowledgments

Comments on an earlier version of the manuscript by Drs. B. Callan and A. Weir are greatly appreciated. This work was supported by the Challenge Grants in Biodiversity Program, Department of Biological Sciences, University of Alberta, and the Alberta Conservation Association (TCL, SPA). Funds from Sustainable Forest Management Network and Natural Sciences and Engineering Research Council of Canada (NSERC) Postgraduate Scholarship (SPA), Izaac Walton Killam Memorial Scholarship (SPA), and NSERC research grants (RSC) are gratefully acknowledged.

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MYCOTAXON

Volume LXXIV(2), pp. 415-422 April-June 2000

CRYPTOPORUS SINENSIS SP. NOV., A NEW POLYPORE FOUND IN CHINA

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ABSTRACT

The polypore *Cryptoporus sinensis* Sheng H. Wu & M. Zang is described as new and separated from *C. volvatus* by smaller spores. Earlier, *Cryptoporus* was recognized as a monotypic genus, with the generic type *C. volvatus*. The new species is close to *C. volvatus*, but has smaller basidiospores. *Cryptoporus volvatus* is known from North America and East Asia. *Cryptoporus sinensis* is hitherto known only from central and southern provinces of China.

Key words: China, *Cryptoporus sinensis, C. volvatus,* new species, polypore.

INTRODUCTION

Cryptoporus (Peck) Shear is generally regarded by mycologists as a member of the Polyporaceae (Basidiomycotina). This genus is distinct from other genera of polypores by the peculiar morphology of the basidioma. The pileus margin of *Cryptoporus* extends over most of the hymenial surface, and the latter is exposed only near the pileus base by an opening in the covering layer. This feature explains the origin of the generic name. In Greek, "crypto-" means covered or hidden. In Latin, "porus" means pore. *Cryptoporus* has long been known as a monotypic genus, with the generic type of *C. volvatus* (Peck) Shear. *Cryptoporus volvatus* is widely distributed in North America and East Asia. According to Gilbertson and Ryvarden (1986), this species is saprobic on various coniferous trees, mainly *Pinus* spp. In this study, *C. sinensis* is described as new from central and southern China.

According to the book "Icones of Medicinal Fungi from China" (Ying et al., 1987), *C. volvatus* has been recorded in many provinces in northern and southern China. The medicinal value of this fungus was described in this book as follows: " To be taken after decoction, it cures bronchitis and asthma, with anti-inflammatory effect. In addition, this fungus contains fragrant substances, and on sucking, it tastes bitter at first, gradually becoming fragrant. People living in the Lijiang district of Yunnan use this fungus orally for infants in order to wean them from breast feeding. In the northwest part of Yunnan, decoction of this fungus with water is popularly used for treating bronchitis and asthma". It would be interesting to compare the medicinal value of *C. volvatus* and *C. sinensis*.

DESCRIPTION OF SPECIES

Cryptoporus sinensis Sheng H. Wu & M. Zang, sp. nov. (Figures 1A-C, 2, 3A-F)

Fructificatio pileata, mediocriter dura, ungulata, dimidiato-orbiculata. Pileus cremeus, flavus, brunneus vel alutaceus. Pori rotundi, 4-5 per mm. Systema hypharum dimiticum. Hyphis generativis fibulatis. Hyphae skeletales ramosae, 1-6 μm diam. Cystidia destituta. Basidia clavata, 15-25 × 7-9 μm, 4-sterigmatibus. Basidiosporae cylindrico-naviculares, laeve, 7.5-10 × 4-5 μm, IKI-, CB-.

Basidiomata fairly tough, solitary or rarely imbricate, sessile, laterally attached by a reduced base, ungulate, surface view dimidiate-circular, up to 3 cm diam., up to 2 cm thick, upper surface variable in color, e.g. cream-colored, yellow, yellowish brown, or tan, usually azonate, glabrous, slightly glossy, occasionally wrinkled; margin cream-colored, obtuse. Pileus margin extends over most of pore surface, with a small opening at the base. The covering of lower surface ivory-colored, up to 1 mm thick. Tube layer wood-colored, up to 4 mm thick. Context whitish, up to 6 mm thick, separated from the tube layer by a thin dark zone. Cuticle thin, fairly hard. Pore surface brown; pores circular, 4-5 per mm.

Hyphal system dimitic; generative hyphae nodose-septate. Contextual skeletal hyphae dominant, colorless, branched, with narrow lumen, 1-6 μm diam.; contextual generative hyphae colorless, 1.5-6 μm diam., thin-walled. Tramal skeletal hyphae similar to those in context, arboriform towards hymenium, much-branched in the hymenial layer; becoming brown towards pore surface. Cystidia lacking. Cystidioles fusoid, 15-25 × 6-11 μm, thin-walled. Basidia clavate, 15-25 × 7-9 μm, 4-sterigmate. Basidiospores cylindrical-navicular, smooth, with 0.3-0.6 μm thick walls, 7.5-10 × 4-5 μm, colorless, IKI-, CB-.

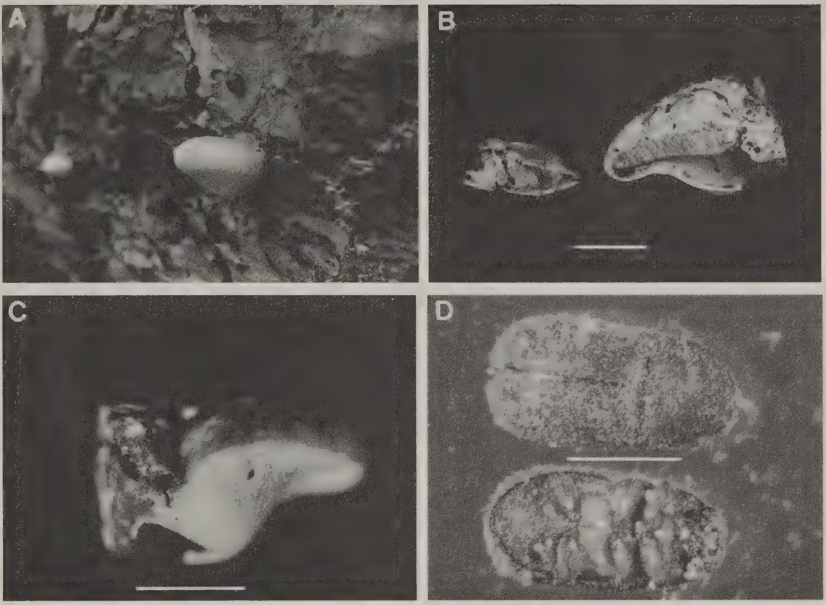

Figure 1. A, Basidiomata of *Cryptoporus sinensis* (*in situ*); B, Lateral sections of basidiomata of *C. sinensis* (left: *Wu 9708-158*; right: holotype), showing the cuticle, context (noting the beetle galleries), tube layer, pore surface, and the covering below pore surface; C, Lateral view of *C. sinensis* (holotype); D, Ciidae species from the basidiomata of *Cryptoporus sinensis* (*Wu 9708-158*). Scale bars = 1 cm (B, C); = 1 mm (D).

Etymology: From sinensis (= China), referring to the country where this new species was found.

Holotype: CHINA. YUNNAN. XISHUANGBANNA: Tatukang, Sawmill, 22.22N, 100.56E, alt. 1 350 m, on trunk of *Pinus khasya*, 15 Aug 1997, *Wu 9708-157* (TNM *M7825*).

Additional specimens examined: CHINA. YUNNAN. XISHUANGBANNA: Tatukang, Sawmill, 22.22N, 100.56E, alt. 1 350 m, on trunk of *Pinus khasya*, 15 Aug 1997, *Wu 9708-158* (TNM *M7826*); KUNMING: 25.04N, 102.42E, on fallen wood, Aug 1990, X.L. Mao *s.n.* (HMAS *70222*(s)). XICHUAN. KANGTING: Shate, alt. 3 400 m, on *Pinus densata*, 31 Jul 1997, P.C. Sun (*2805*) (HKAS *31204)*. JIANGXI: Jinggangshan, 26.34N, 114.10E, on fallen wood, 15 Jul 1985, Q.X. Wu (*136*) (HMAS *57538* (s)). FUJIAN. QINGLIU: 26.10N, 116.48E, 30 Jul 1974, Q.M. Ma (*500*) (HMAS *42173* (s)); SANMING: 26.13N, 117.36E, 23 Jul 1974, Q.M. Ma (*84*) (HMAS *41197*(s)). HUBEI. WUHAN: 30.35N, 114.17E, on rotten wood, Aug 1965, S.C. Teng *s.n.* (HMAS *34729* (s)).

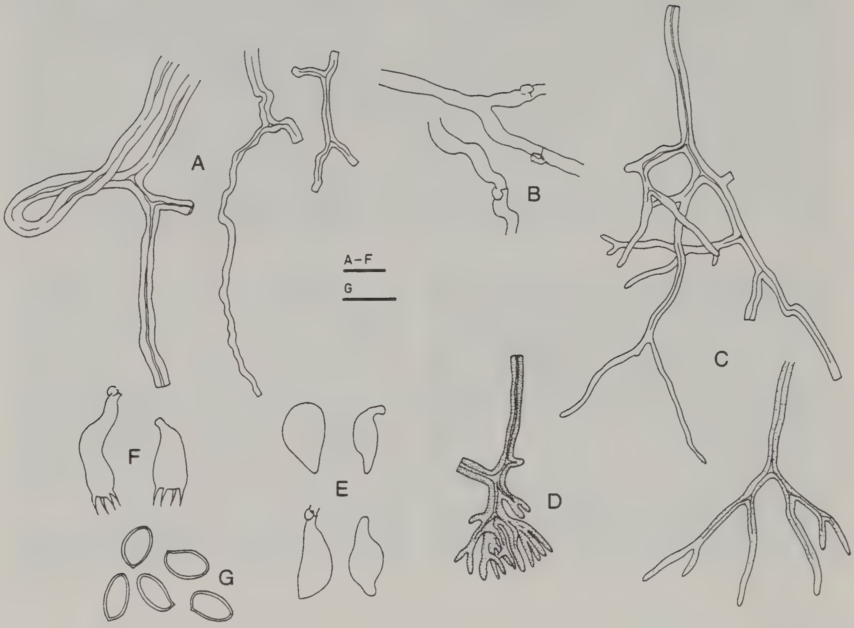

Figure 2. *Cryptoporus sinensis* (holotype). A, Contextual skeletal hyphae; B, Contextual generative hyphae; C, Tramal skeletal hyphae; D, Much-branched skeletal hyphal terminals near pore surface; E, Cystidioles; F, Basidia ; G, Basidiospores. Scale bars = 10 μm.

Distribution: Known from central and southern China.

Cryptoporus volvatus (Peck) Shear, Bull. Torrey Bot. Club. 29: 450. 1902. (Figures 3G-L)

Basionym: *Polyporus volvatus* Peck, N.Y. State Mus. Ann. Rept. 27: 98. 1877.

A description, line drawing, and discussion of this species have been comprehensively provided by Gilbertson and Ryvarden (1986).

Specimens examined: USA. NEW YORK: Adirondacks Forest, Indian Lake, leg. C.H. ck, VII-1873 (holotype, NYS). CALIFORNIA. ALAMEDA CO.: Berkeley, University of California Campus, West across creek from Life Sciences, in open grove of *Pinus* and *Quercus agrifolia*, on log of *Pinus radiata*, appearing the year after tree was cut, Feb 1978, Isabelle Tavares (*2530*) (H, K, ex UC). OHIO. ROSS CO.: Scioto Trails State Park, on *Pinus resinosa*, 27 Apr 1975, W.B & V.G. Cooke (*49671*) (K(mycological collections) *56027*); MARYLAND: Sligo, on *Pinus* sp., 8

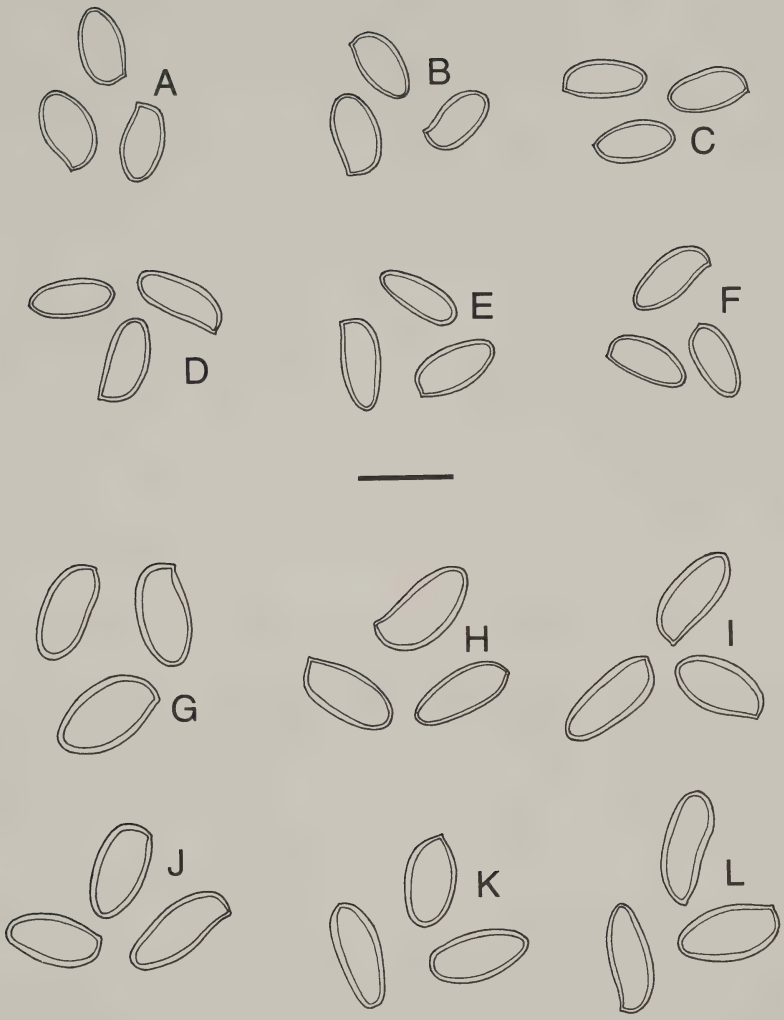

Figure 3. A-F: Basidiospores of *Cryptoporus sinensis*. A, China: Yunnan (*Wu 9708-157*, holotype); B, China: Yunnan (*Wu 9708-158*); C, China: Yunnan (HMAS *70222*(s)); D, China: Hubei (HMAS *34729* (s)). E, China: Jiangxi (HMAS *57538* (s)); F, China: Fujiang (HMAS *41197*(s)). G-L: Basidiospores of *Cryptoporus volvatus*. G, USA: New York (holotype); H, Canada: British Columbia (*Kennedy 403*); I, Russia: Primorsk (TAA *105311*); J, Japan: Ehime (TMI *2974*); K, China: Hainan (BPI *US0235707*); L, Vietnam: Tonkin (*LBA 133*). Scale bar = 10 µm.

May 1904, C.L. Shear *s.n.* (BPI *US0235706*). VIRGINIA: Camp Humphreys, on *Pinus* sp., 11 May1930, Nellie W. Nance *s.n.* (BPI *US0235709*). CANADA. BRITISH COLUMBIA: Victoria, on spruce wood, 15 May 1947, L.L. Kennedy (*403*) (H, ex ALTA); Vancouver Island, Cordova Bay, dead wind fallen *Abies grandis*, 22 Sep 1968, W.G. Ziller *s.n.* (K(mycological collections) *56028*). RUSSIA. PRIMORSK: USSURIJSK: Ussurijsk Nature Reserve, on *Pinus koraiensis*, 22 May 1983, E. Parmasto *s.n.* (O, ex TAA *105311*). JAPAN. EHIME. OZU CITY: Mt. Higashiu, on *Pinus* sp., 6 May 1963, K. Tashise *s.n.* (TMI *2974*); NAGASAKI: Shimoagata-gun, Izuhara-machi, on *Pinus thunbergii*, 24 Jul 1973, I. Ohira *s.n.* (TMI *2975*); TOTTORI. TOTTORI CITY: Kokoge, 27 May 1979, E. Nagasawa *s.n.* (TMI *16739*); CHUGOKU. FUSUTA. HIROSHIMA: On living trunk of *Pinus* sp., 5 May 1944 (Hongo herb. No. *618*, K(mycological collections) *56029*). CHINA. HAINAN. TAN HSIEN: On pine, 6 Oct 1934, S.T. Teng *s.n.* (BPI *US0235707*). VIETNAM. TONKIN: Eberhadt, *LBA 133* (O, ex FH).

Distribution: North America and East Asia.

DISCUSSION

Cryptoporus sinensis has smaller basidiospores (7.5-10 × 4-5 μm) than *C. volvatus* ((9-)10-12.5 (-13.5) × (4.5-) 5-6 (-7) μm). The spore size difference is the only morphological difference detected between these two species. *Cryptoporus volvatus* has a widespread distribution in North America and East Asia, but is mostly recorded in temperate regions. *Cryptoporus sinensis* is so far known from central and southern provinces of China. The possibility that *C. sinensis* represents a small-spored form of *C. volvatus* originating from regions with warmer climate has been excluded, because specimens from more southern areas (Hainan of China and Vietnam) also bear large spores typical of *C. volvatus*. *Cryptoporus sinensis* may have evolved from *C. volvatus* in central and southern China.

Measurements of spores from Chinese specimens of *C. volvatus* by mycologists seem to include elements of this species and *C. sinensis* (e.g., 8.5-13 × 3.9-6.2 μm by Ying et al., 1987). Teng's (1939, 1996) spore measurements (10-13 × 4.5-6 μm) from Chinese specimens only represent the spore range of *C. volvatus*. Zhao and Zhang (1992) noted the differences in spore sizes between their measurements (7.5-10.5 × 4-5 μm) and Teng's measurement. Zhao and Zhang's measurement reflects the spore size of *C. sinensis*.

Ryvarden (1991) suggested a close relationship between *Cryptoporus* and *Trametes* Fr., due to the trimitic hyphal system and cylindrical spores. Hibbett and Donoghue (1995) have inferred that *Cryptoporus* and *Trametes* belong to one of their seven studied groups, based on a phylogenetic classification of the Polyporaceae through parsimony analysis of mitochondrial ribosomal DNA sequences. Moreover, *Ganoderma* P. Karst. is the closest genus to *Cryptoporus* among the genera that they studied.

Both *C. volvatus* and *C. sinensis* do have branched skeletal hyphae of the "arboriform" type which is uniformly present in *Ganoderma* spp. This type of skeletal hypha has not previously been noted in the genus *Cryptoporus*. *Cryptoporus* also resembles *Ganoderma* in having thick-walled basidiospores, but they are smooth and not with intra-wall pillars as in *Ganoderma*. The glossy and brown pileus surface of *Cryptoporus* is similar to that of many species of *Ganoderma*. *Cryptoporus* was described as trimitic (Gilbertson and Ryvarden, 1986) with branched skeletal hyphae and binding hyphae. In this study, we did not find binding hyphae in basidiomata of either *C. sinensis* or *C. volvatus*. The hyphal system of *Cryptoporus* should be further studied.

One small insect species of the family Ciidae (tree-fungus beetles) was usually found in basidiomata of *C. sinensis* collected by the authors from Yunnan (Figure 1D). Small holes present in the context of these basidiomata were indicative of these insects. A collection was even completely eaten by this insect species during storage. Similarly, basidiomata of *C. volvatus* are likely to be eaten by certain insect species (E. Parmasto, pers. comm.).

ACKNOWLEDGMENTS

The authors are indebted to the curators of BPI, H, HMAS, K, NYS, O, and TMI for arranging loans of specimens for this study, and to Miss M.L. Chan for help in identifying the insects in basidiomata of *C. sinensis*. We are obliged to Dr. L. Ryvarden for reviewing the manuscript. We are also grateful to Ms. Cheryl Robbins for revising the English.

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中華隱孔菌 (CRYPTOPORUS SINENSIS)，發現於中國的新種多孔菌

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中華隱孔菌 (*Cryptoporus sinensis* Sheng H. Wu & M. Zang) 於本文中發表為多孔菌新種。過去隱孔菌屬 (*Cryptoporus*) 被視為單種屬，其模式種為 *C. volvatus* (Peck) Shear。中華隱孔菌近似 *C. volvatus*，唯擔孢子較小。*Cryptoporus volvatus* 分佈於北美及東亞，而 *C. sinensis* 則僅知於華中及華南。*Cryptoporus volvatus* 在中國為傳統醫用真菌。*Cryptoporus sinensis* 及 *C. volvatus* 的成員過去在中國均被處理為後者之名。

關鍵詞：中國，中華隱孔菌 (*Cryptoporus sinensis*)，隱孔菌 (*C. volvatus*)，新種，多孔菌。

MYCOTAXON

Volume LXXIV(2), pp. 423-427 April-June 2000

NOTES ON GOMPHALES: RAMARIA RIELII

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Abstract: Identity of *Ramaria rielii* Boud. is discussed on the basis of the find and study of its type. This is a distinct species from *R. botrytis* (Pers.:Fr.) Bourdot, with which it has been long confused.

Keywords: Gomphales, *Ramariaceae*, *Ramaria rielii*, taxonomy.

Resumen: Se discute la identidad de *Ramaria rielii* Boud. a partir del estudio del material tipo, localizado en el herbario PC. Se trata de una especie independiente y que hasta el momento se la relacionaba con *R.botrytis* (Pers.:Fr.) Bourdot. Se incluye una tabla comparativa con las especies mas próximas.

Palabras clave: Gomphales, *Ramariaceae*, *Ramaria rielii*, taxonomía.

Introduction

Boudier (1897a:13) described a new species of *Ramaria* from Grande-Chartreuse (Isère, France) which was dedicated to Dr. Riel, who collected it. Boudier stated that "Cette (...) espèce a la couleur et la taille du *Ramaria formosa*, mais s'en distingue bien à ses rameaux bien moins divisés, presque simples, bien plus épais et obtus au sommet et par ses spores plus grandes de 16 à 18µ de longueur tandis que celles de formosa n'atteignent que 12. (...). Le sommet des rameaux est toujours obtus, (...) et jaune citron quand il est érodé. Les stries (...) sont longitudinales, plus ou moins ondulées et en occupent toute la longueur. La chair est fine et douce et formée d'hyphes allongées, septées, d'environ 10µ de diamètre".

Maire (1911:449) when arguing about the deterioration of *Clavaria botrytis* discussed that "Nous avons trouvé des spécimens dans cet état à la Grande-Chartreuse. Ces spécimens ressemblent extraordinairement au *Ramaria Rielii* Boud. (...) qui n'en differe guère que par sa chair jeune sous l'hymenium. Comme le *R. Rielii* a des spores très grandes (...) et comme provient justement de la Grande-Chartreuse, où nous n'avons rencontré que *C. Botrytis*, on peut se demander si le champignon de Boudier n'est pas (...) un trognon de *Clavaria Botrytis*."

Except Bourdot & Galzin (1927:94), subsequent authors have considered *R. rielii* as a strange form of other species of *Ramaria* or, generally, they have accepted Maire's suggestion of an old and deteriorated specimen of *R. botrytis*.

Coker (1923:149) suggested that *R. rielii* and *Clavaria strasseri* Bres. [≡*Ramaria strasseri* (Bres.) Corner] were the same species. If so, it should be named *R. rielii* Boud. since this name has nomenclatural preference (*R. rielii* Boud.1897 and *C. strasseri* Bres. in Strasser

1900:296). Cotton & Wakefield (1919:172) and Corner in his Monograph (1950:560) accepted Maire's judgement. Thus *R. rielii* has remained a synonym of *R. botrytis* and it has scarcely been mentioned later (McAfee & Grund 1981:36, Jülich 1989:107).

Material and Methods

During a stay in the Muséum National d'Histoire Naturelle, Paris, the type of *R. rielii* was located in the Boudier herbarium (PC). The type consists of a pressed specimen sectioned into 2 pieces.

Other samples examined were: Representative specimen of *C. botrytis* Pers.:Fr. at UPS (cf Petersen 1971:372); Holotype of *R. claviramulata* Marr & D.E.Stuntz at SUCO; Holotype of *R. sardiniensis* Schild & Ricci at ZT. For *R. strasseri* (Bres.) Corner, measurements were taken from Christan 1994:63.

Color references and fresh measurements are those taken from the author's illustrations (Boudier 1896 and 1897b) which were drawn at natural size. Color designation when dry are those of ISCC-NBS (1964).

All microscopic measurements were made into 3% KOH; spore measurements do not include apiculus nor ornamentation (L=spore length, W=spore width, E=L/W; Lm=mean L, Wm=mean W, Em=mean E, measures=50).

Ramaria rielii **Boud.,** ***Bull. Soc. Mycol. France*** **13:13. 1897.**

Typus: PC, Herb. Boudier. Grande-Chartreuse (Isère), in fagetis et abiegnis mixtis. Septembre 1896, legit doct. Riel.(!).

Macroscopy:

Basidiome fasciculate, 12 x 5 cm., scarcely ramified with thick and densely packed branches forming an obovoid compact mass.

Base white to cream, 2.5 x 3 cm. (Boudier 1897a), glabrous, strong and subbulbous. Whitish to ochre (about 70.l.OY) when dry.

Branch ramification (axils) acute, into 1-2(3) ranks, polychotomous. Primary branches common, 1-1.5 cm thick (Boudier 1897a), cylindrical to claviform, almost single, somewhat fused below. Branches sometimes flattened (Boudier 1896). Outer surface longitudinally grooved, somewhat winding, 0.5-1.3 mm wide and locally labyrinthiform when fused together. Grooves of orange salmon color and disappearing toward the base. Orange-brown color (77.m.yBr) when dried. Internodes up to 3 cm length.

Hymenophore amphigenous, with spore accumulation into grooves and points of branching. Spores yellowish orange (71.m.OY, 72.d.OY) in mass.

Apex obtuse, blunted, strong (up to 1.5 cm wide), not ramified nor well defined; with a labyrinthiform design because of the confluence of surface grooves there; of the same color as branches or lemon yellow when eroded.

Flesh white, yellow near hymenium; taste mild, not bitter (teste Boudier). Inner flesh spongy when dried, softer towards the base.

Microscopy:

Monomitic, tramal hyphae without clamps, 3.5-6(13) µm wide, somewhat wider at the base, (5.7)9.5-13(15.3) µm, strangulated at the septa. Wall up to 0.5 µm wide, hyaline. Ampulliform septa up to 16 µm wide, clearly ornamentated with short tips. Hyphae parallel to subparallel on the border and interwoven inwards, not congested. Secretory hyphae not seen.

Subhymenial hyphae about 2 µm wide, hyaline, with a thin wall, not clamped and interwoven.

Basidia 70-80 x 10 µm (teste Boudier), claviform, unclamped, hyaline but commonly guttulate, sterigmata 4, about 6 µm long. They are in bad condition and break or collapse easily.

Spores yellowish, subcylindrical, sometimes sigmoid, (15)16.6-18.8(22,3) x (4)4.7-5.8(7) µm, Lm=17.69, Wm=5.25, E=(2.54)3.10-3.73 (5.58), Em=3.41 (16-18 x 5-7 according to Boudier), cyanophilous.

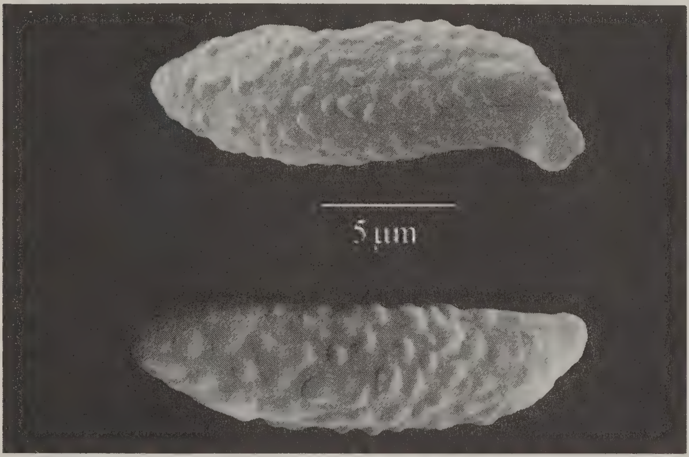

Fig.1. Spores of *R. rielii.*

Spore wall up to 0.4 µm thick. Ornamentation conspicuous all over the surface, warty without particular orientation or somewhat longitudinally arranged but not grooved (see fig.1). Homogeneous or with a yellow, refringent guttule inside, rarely multiguttulate. Apiculus prominent, up to 1.5 µm length.

Ecology: On mixed woods with fir (*Abies/Picea*) and beech (*Fagus sylvatica*).

Observations: Boudier (1897a,b) pointed out the presence of cystidia on the hymenium. No cystidia on the type have been located by us.

Conclusions

In view of the characters described, the studied exsiccata can not be *R. botrytis* nor *R. strasseri* because both species have spores with oblique striae, clamped hyphae and well-defined apices which are clearly ramified. On the other side, *R. rielii* has verrucose spores, unclamped hyphae and a non-ramified apex (see table 1); moreover, Lm value is up to 4µm higher.

	Clamped hyphae	Spore ornamentation	Lm	Em	Definite apex
R. botrytis	Yes	striae	13.90	2.91	Yes
R. rielii	**No**	**warts**	**17.69**	**3.41**	**No**
R. strasseri	Yes	striae	13.70	2.59	Yes

Table 1.

Thus, *R. rielii* belongs to subgenus *Laeticolora*. There are scarcely any species without clamps and with a grooved hymenium known in this subgenus. Even if its original colors when fresh are those offered by Boudier (1896, 1897b) or they are the result of a rufescent reaction (which might explain the yellow shades on the subhymenium), this species can be related with *R. claviramulata* Marr & D.E.Stuntz or with *R. sardiniensis* Schild & Ricci. A comparative table is the following:

	Lm	Spore ornamentation	Hymenium	Apex
R.claviramulata	10.42	warts forming pseudostriae or single	Subrugose	Blunted, some ramified
R.rielii	**17.69**	**single warts**	**Longitudinally grooved**	**Blunted**
R.sardiniensis	9.23	warts forming pseudostriae or single	Subrugose to slightly grooved	Blunted and fused or scarcely separate

Table 2.

R. sardiniensis is a recently described species (Schild 1998) which differs by its Lm value and by the higher ramification rank. Also by its branch thickness, which is from 2.3 to 6 mm at the base in *R. sardiniensis* and from 10 to 15 mm at the branch apices in *R. rielii*. It shows a color change towards blackish on the base, which is not referred to by Boudier.

R. claviramulata is also somewhat close to *R. rielii* but Lm value is up to 7µm longer in the latter and spore ornamentation is different too (see table 2).

Acknowledgements:

We would like to thank to the DGES on its Flora Micológica Ibérica project (PB96-0129) under which this work was completed. Also to the Muséum National d'Histoire Naturelle, Paris (PC) specially to Dr.Buyck, Dr.Couté and Dr.Mascarell for their help during the stay of one of us (P.P.D.). To M.Jerez for his help with the S.E.M. To the following herbaria for loaning type specimens: Uppsala (UPS), Oneonta (SUCO) and Zurich (ZT). In the same way to F.Pando for his assistance and management.

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MYCOTAXON

Volume LXXIV(2), pp. 429-445 April-June 2000

A COMPARISON AMONG THE LICHEN FLORAS OF THREE CLIMATICALLY DIFFERENT LOCALITIES IN SOUTH WEST GREENLAND

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ABSTRACT

A total of 229 taxa of lichens including a few lichenicolous fungi are reported from Qeqertarsuatsiaat/Fiskenæsset, Qussuk and Sangujaarssuit situated in the Nuuk District, South West Greenland. Dominant species were recorded by estimating the cover percentage of all taxa in the different plant communities. The following habitat factors were estimated: rock type and texture, occurrence of limonite crusts and guano, and moisture conditions. The lichen flora of the three localities, which differ from each other climatically, is compared.

The coastal locality, Qeqertarsuatsiaat, is characterised by its conspicuous ornithocoprophilous lichen vegetation consisting of species such as *Aspicilia caesiocinerea*, *Physcia caesia, Protoparmelia badia* and *Xanthoria elegans* and a particular community of lichens tolerant of high concentrations of iron, for example, *Acarospora smaragdula*, *A. sinopica* and *Tremolecia atrata*. Well developed snowbeds dominated by *Salix herbacea*, *Cladonia ecmocyna*, *Peltigera scabrosa and Solorina crocea* are of great importance on the Qeqertarsuatsiaq island. *Empetrum hermaphroditum-Vaccinium uliginosum* heaths rich in "fell-field lichens" such as *Alectoria ochroleuca*, *Bryocaulon divergens* and *Flavocetraria nivalis* also occur in many places on this island. Epiphytic lichens are of minor importance at Qeqertarsuatsiaat.

The comparatively varm summers at Qussuk favours the development of scrub vegetation. Accordingly the epiphytic lichen flora, represented by species such as *Cetraria sepincola*, *Lecanora fuscescens, Parmeliopsis ambigua* and *Varicellaria rhodocarpa*, is more rich at this locality than at Qeqertarsuatsiaat. Mixed dwarf shrub heaths dominated by *Betula nana*, *Empetrum hermaphroditum*, *Ledum groenlandicum* and *L. palustre, Vaccinium uliginosum* and rich in macrolichens such as *Cladonia stellaris*, *C. stygia*, *C. mitis* and *Stereocaulon paschale* are widely distributed at Qussuk. The lichens form almost pure lichen heaths in the area. More dry heaths and fell-fields with *Flavocetraria nivalis*. *Sphaerophorus globosus* and species of *Alectoria* occur on hills and in other less protected places. Seepage rocks support lichens such as *Ephebe hispidula*, *Massalongia carnosa*, *Polychidium muscicola* and *Vestergrenopsis isidiata*. Contrary to lichens associated with iron-containing crusts ornithocoprophilous lichens and lichens occurring on dry, gneissic rocks without guano are of great importance at Qussuk.

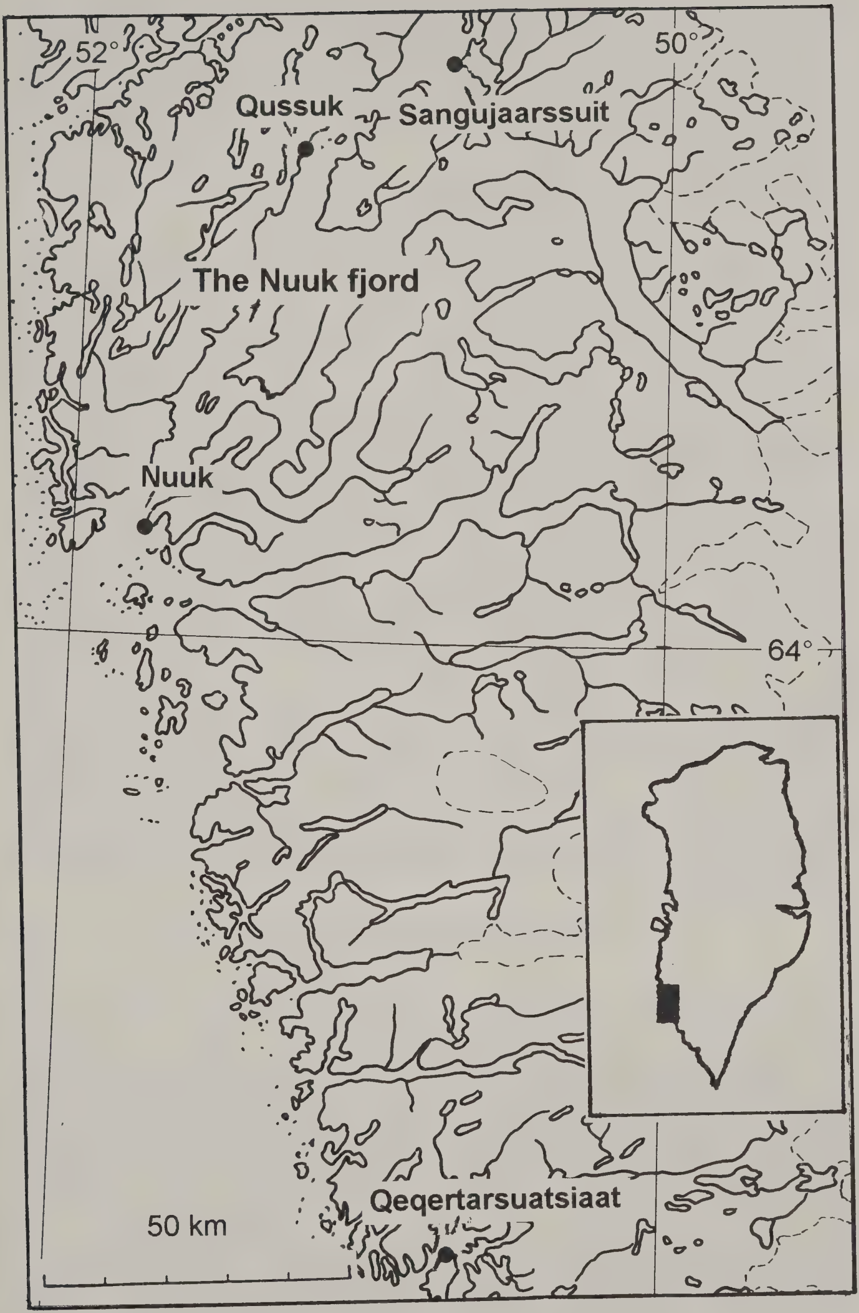
The richest epiphytic lichen flora was found on *Alnus crispa* and *Betula nana* near the head of Sangujaarssuit. The two shrub species have many lichens in common, for example, *Arthopyrenia punctiformis, Lecanora fuscescens, Melanelia septentrionalis* and *Parmeliopsis ambigua*. *Phaeocalicium compressulum* is a typical epiphyte on *Alnus*. Normal terricolous lichens such as *Caloplaca ammiospila, Cladonia cyanipes* and *Psoroma hypnorum* often colonize the basal parts of the shrubs. Many *Peltigeras*, for example, *Peltigera kristinssonii* and *P. leucophlebia*, grow among mosses such as *Hylocomium splendens* and *Pleurozium schreberi* in open scrubs composed of *Alnus crispa* or *Salix glauca*. Heath mosaics composed of *Betula nana, Empetrum hermaphroditum*, *Ledum groenlandicum, Salix glauca* and *Vaccinium uliginosum* are rich in lichens such as *Buellia papillata* and *Nephroma expallidum*. A *Salix herbacea-Sibbaldia procumbens* snowbed appears to be rich in lichens characterised by a mainly coastal distribution in Greenland (for example, *Pertusaria oculata* and *Solorina crocea*). The saxicolous lichen flora of the Sangujaarssuit area contains a southern inland-element represented by, for example, *Lasallia pensylvanica*, *Lobaria scrobiculata* and *Nephroma bellum*. Ornithocoprophilous lichens are common in the area.

KEY WORDS: Lichen flora, Greenland.

INTRODUCTION

Dahl (1950) and Hansen (1993) have given an account of the previous research on lichens in the Nuuk District. It shows that the collecting activity has varied rather much from area to area within the district. Thus localities such as Nuuk, Qornoq, Kapisillit and the Ameralik fjord must be considered to be fairly well investigated lichenologically, while, for example, Qeqertarsuatsiaat and the greater part of the Nuuk fjord, have an incompletely known lichen flora (Fig. 1).

Fig. 1: The Nuuk fjord area and the Qeqertarsuatsiaat/Fiskenæs area showing the three collection localities, Qeqertarsuatsiaat/Fiskenæsset, Qussuk and area near the head of Sangujaarssuit. The small map to the right shows the location of the investigation area in Greenland.


52°
50°
Qussuk
Sangujaarssuit
The Nuuk fjord
Nuuk
64°
Qeqertarsuatsiaat
50 km

The author investigated the lichen flora of the surroundings of Qeqertarsuatsiaat in the summer of 1993. In the summer of 1997 the author explored the lichen flora of Qussuk and an area near the head of Sangujaarssuit in collaboration with members of the staff of the Greenland Institute of Natural Resources and the National Environmental Reseach Institute, Department of Arctic Environment, respectively. Qeqertarsuatsiaat (63°06′N, 50°40′W) is situated at the northernmost corner of Qeqertarsuatsiaq island (max. alt. 220 m a.s.l.; Fig. 1). The town is facing Fiskenæsfjorden, which extends to the outer coast. It is located c. 150 km to the south of Nuuk, the capital of Greenland. Qussuk (64°43′N, 51°18′W) is situated on the northern extension of Nordlandet/Akia characterised by its many lakes and up to 200 m high hills. The locality faces Qugssuk, a northern branch of the Nuuk fjord. The distance between Qussuk and Nuuk is c. 65 km.

The third locality is an area situated near the head of Sangujaarssuit (64°52′N, 50°47′W), which is a western branch of the fjord, Ilulialik, a northern extension of the Nuuk fjord. A 570 meter high mountain partly shelters the area. The vegetation is best developed on southeast-facing slopes and at the foot of the mountain. Archaean granodioritic gneisses predominate in the investigation areas (Escher & Stuart Watt, 1976; Kalsbeek & Garde, 1989). The gneisses contain layers of amphibolite and anorthosite (Qeqertarsuatsiaat) and are cut by swarms of mafic dykes of early Proterozoic age. Unfortunately, only a sparse meteorological information is available from the three localities. However, the climate of Qeqertarsuatsiaat is comparable with that of Nuuk, which falls within the low arctic, oceanic regime (Dahl, 1950; Böcher, 1954). According to measurements made by ASIAQ/Grønlands Forundersøgelser the mean temperature of July is c. 7°C at Nuuk. The mean temperature of the coldest month, February, is -7.5°C. The normal annual precipitation at Nuuk is 756 mm (1993-1997) at Nuuk. The Nuuk fjord area is characterised by an oceanic-continental gradient (Hansen, 1993; Heide-Jørgensen & Johnsen, 1997), which implies that inland summer temperatures are higher than coastal summer temperatures, and that precipitation is higher at the coast than at inland localities. In accordance with this climatic pattern Qussuk has a low arctic, suboceanic climate, whereas that of the Sangujaarssuit area is low arctic and subcontinental (-continental).

MATERIAL AND METHODS

Lichens were collected at more than 100 sample plots situated at Qeqertarsuatsiaat, Qussuk and near the head of Sangujaarssuit. Moisture conditions, rock type and texture and occurrence of limonite crusts and guano were recorded at the different lichen habitats. Dominant species were recorded by estimating the cover percentage of all taxa in all plant communities rich in lichens. The surface examined in analysis of terricolous communities is one square metre (all localities, but primarily Qeqertarsuatsiaat) or 71x71 cm (Qussuk, Sangujaarssuit), while it is 10x10 cm in analysis of saxicolous communities (all localities). Numerous random samples of lichens were collected for a complete investigation of the different vegetation types. Dominant epiphytic lichens were recorded by an evaluation of the most prevalent species on selected branches and twigs. The collected material, a total of 911 lichen specimens, is deposited at the Botanical Museum, University of Copenhagen (C). A study collection of lichens from Qussuk, Sangujaarssuit and Nuuk is kept at the Greenland Institute of National Resources. The classification of vegetation types and plant communities is in accordance with that previously used by Hansen (1993, 1997). Within each of the three main types of flora (corticolous, terricolous and saxicolous flora) the different plant communities occurring at the three localities are described and discussed.

RESULTS AND DISCUSSION

The present study shows that the composition of the lichen flora and vegetation varies to some extent with the distance between the locality and the outer coast. The largest number of lichen taxa was found at the coastal locality, Qeqertarsuatsiaat (totally 161; Table I). The Sangujaarssuit area is also comparatively rich in lichen taxa (151), while only 138 taxa were recorded at Qussuk. This locality contains, however, the largest growths of terricolous lichens apart from some *Peltigeras* and species such as *Icmadophila ericetorum*, which are best developed on mossy ground in open scrubs at the inland locality. Outer coast localities are often poorer in lichen species than localities situated in the inland because of more severe climatic conditions. This is well illustrated by an example from the Julianehåb district, where Akia and Harefjeld, both characterised by low summer temperatures and much fog, contain only half as many lichen species as Narssarssuaq (Hansen, 1978a). An account of the lichen vegetation of Qeqertarsuatsiaat, Qussuk and the investigated area at Sangujaarssuit is provided below.

Table I

	I	II	III
Corticolous lichens	2	5	12
Terricolous lichens	75	69	69
Saxicolous lichens	84	64	70
Total number of lichens	161	138	151

Table I: The total number of corticolous -, terricolous - and saxicolous lichens occurring at the three collection localities (see Fig. 1).

A. Corticolous flora

Nuuk and Qeqertarsuatsiaat are very poor in epiphytic lichens owing to the comparatively cold summer climate (Hansen, 1993). *Lecanora fuscescens* was found growing together with *Biatora vernalis* on prostrate branches of *Salix glauca* south of the town. The last-mentioned lichen usually occurs on plant remains in this area. No corticolous lichens were found on the scattered shrubs of *Betula nana* occurring on Qeqertarsuatsiaq island.

With its more favourable climate Qussuk has many scrubs and, therefore, also a comparatively rich epiphytic lichen flora (Table I). *Cetraria sepincola*, *Lecanora fuscescens, Parmeliopsis ambigua* and *Varicellaria rhodocarpa* grow on up to 2 cm thick branches of *Betula nana*. Basal branches of this shrub appear to be a suitable substrate for the terricolous lichens, *Cetraria islandica* and *Ochrolechia frigida* (!). Two normally epilithic lichens, viz. *Parmelia saxatilis* and *Pseudephebe pubescens*, occur very rarely on such branches at Qussuk. One obligate epiphytic lichen, *Cetraria sepincola*, and two lichens usually occurring on rocks, viz. *Cetraria hepatizon* and *Pseudephebe minuscula*, were found growing on a 3 cm thick branch of *Salix glauca*. *Bryonora castanea, Buellia papillata* and *Psoroma hypnorum* occur on dead branches of *Salix*.

Alnus crispa forms extensive and up to almost three metre high thickets on the southeast-facing side of the mountain near the head of Sangujaarssuit. More open scrubs occur in the lowland below this mountain. A fairly rich flora of epiphytic lichens was found on up to three cm thick branches of *Alnus*. It consists of the following twelve species: *Arthopyrenia punctiformis*, *Caloplaca holocarpa*, *Cetraria sepincola*, *Lecanora fuscescens*, *L. symmicta*, *Melanelia septentrionalis* (dominant), *Parmeliopsis ambigua*, *P. hyperopta*, *Pertusaria carneopallida*, *Phaeocalicium compressulum, Rinodina lecideoides* and *Varicellaria rhodocarpa* (Table I). *Parmeliopsis ambigua* and *P. hyperopta* occur most abundantly on the thickest branches, while other species, for example, *Cetraria sepincola*, most frequently occur on thin branches and twigs. Thus it appears that the investigated locality has many corticolous lichens in common with, for example, Kapisillit (Hansen, 1993). However, terricolous lichens such as *Caloplaca ammiospila*, *Cladonia chlorophaea*, *C. cyanipes*, *Cladonia deformis* and *Psoroma hypnorum* which were found growing on the lowest part of the *Alnus* shrubs, are more common at Sangujaarssuit than at Kapisillit. *Parmelia saxatilis*, which usually grows on rocks in Greenland, rarely colonizes the bark of *Alnus* in the Nuuk fjord area. It is also able to colonize the branches of, for example, *Betula pubescens, Juniperus communis* and *Sorbus groenlandica* (Alstrup, 1982).

Betula nana also appears to be rich in corticolous lichens in the Sangujaarssuit area. *Arthopyrenia punctiformis, Cetraria sepincola*, *Lecanora fuscescens*, *L. symmicta*, *Melanelia septentrionalis*, *Parmeliopsis ambigua* (occasionally lignicolous) and *Varicellaria rhodocarpa* are obligate epiphytic lichens, whereas the following species have a lower substrate specificity: *Cetraria hepatizon*, *Cladonia amaurocraea, C. chlorophaea, C. cornuta, C. deformis, Hypogymnia austerodes*, *Parmelia saxatilis*, *P. sulcata*, *Rinodina turfacea* and *Xanthoria borealis* (frequently saxicolous). *Cladonia amaurocraea* are restricted to the basal part of the *Betula nana* shrubs. Normally terricolous lichens are also commonly found on the lowest twigs of *Betula nana* at Qasigiannguit in the Disko Bugt area, but in the last case fell-field species such as *Alectoria nigricans* and *A. ochroleuca* replace the *Cladonia* species (Hansen, 1997).

B. Terricolous flora

1. Qeqertarsuatsiaat/Fiskenæsset

The epigaeic lichen flora of Qeqertarsuatsiaat is richer in species than that of Qussuk and the area at Sangujaarssuit (Table I). The lichen vegetation includes three different plant communities, viz. snowbeds (including snowbed heaths), dwarf shrub heaths and fell-fields.

Snowbeds dominated by *Salix herbacea* are best developed on northward-facing slopes and occur in many places on the Qeqertarsuatsiaq island. They are generally poor in lichen species, although some species, for example, *Cladonia ecmocyna* and *Solorina crocea*, often cover large areas along the border of the snow-patches (Hansen, 1971). A snowbed heath of particular interest occurs on strongly sloping ground below a rock wall just south of Qeqertarsuatsiaat. It is rich in mosses, for example, *Hylocomium splendens* and *Pleurozium schreberi*, and contains numerous lichens, in particular *Cladonias* and *Peltigeras*. Species such as *Cladonia arbuscula*, *C. crispata*, *C. mitis*, *C. phyllophora*, *C. stygia*, *C. uncialis*, *Flavocetraria nivalis, Peltigera canina*, *P. leucophlebia*, *P. malacea*, *P. rufescens*, *P. scabrosa* (dominant) and *Stereocaulon alpinum* indicate the heath character of this community, but the previously mentioned "snowbed-lichens" are also of great importance in this vegetation mosaic. *Ochrolechia frigida*, *O. lapuënsis* and *Pertusaria geminipara* cover dead mosses and other plant fragments. *Baeomyces rufus, Cladonia bellidiflora*, *C. pleurota and C. squamosa* were often found growing on bare soil.

Dwarf shrub heaths dominated by *Empetrum hermaphroditum* and *Vaccinium uliginosum* occur in many places on the Qeqertarsuatsiaq island. They are especially rich in lichens on the top of hills and on plateaus. *Flavocetraria nivalis* is dominant at these sites with *Alectoria nigricans*, *A. ochroleuca*, *A. sarmentosa* ssp. *vexillifera*, *Bryocaulon divergens, Cetraria muricata*, *Sphaerophorus globosus* and *Thamnolia vermicularis* (v. *subuliformis*) as important additional lichens. However, dwarf shrubs are of minor importance in areas, which are particularly exposed to strong winds. True fell-field vegetation composed of the lichens just mentioned is usually developed in such areas. Moist *Vaccinium* heaths are restricted to depressions in the terrain. They often appear to be rich in lichens such as *Cetrariella delisei, Cladonia mitis* and *C. stricta* and *Arctocetraria andrejevii* with *Cladonia cornuta, C. cyanipes*, *C. pleurota* and *C. sulphurina* growing on the top of tussocks (Hansen, 1971). *Cladonia stellaris* preferably occurs along the border of stands of *Vaccinium uliginosum*. At some distance from the sea *C. stellaris* forms a very conspicuous association together with *Flavocetraria nivalis*, but although it is rather common on the island, it cannot be compared with the large growths occurring at Qussuk. *Cladonia floerkeana*, which has a somewhat scattered distribution in South West Greenland (Hansen, 1995a), was found growing in a single place close to the sea.

2. Qussuk

This locality is primarily characterised by its often rather complex types of dwarf shrub heaths, most of which contain many lichens. However, bogs and fell-fields are additional plant communities more or less rich in lichens. Dahl´s statement - that lichen heaths are most luxuriantly developed in the middle of the South West Greenland fjords (Dahl, 1950) - applies perfectly to those occurring at Qussuk. Snowbeds are of minor importance, only.

Mixed dwarf shrub-lichen heaths are widely distributed in the Qussuk area. *Betula nana*, *Empetrum hermaphroditum*, *Ledum palustre, L. groenlandicum* and *Vaccinium uliginosum* often are the dominant dwarf shrubs, although their individual importance in the heaths varies to some extent. *Cladonia stellaris* is usually the dominant lichen, but species such as *Cladonia mitis*, *C. stygia*, *Flavocetraria nivalis*, *Nephroma arcticum*, *Peltigera aphthosa*, *Stereocaulon alpinum* and *S. paschale* also cover comparatively large areas. The rather frequent occurrence of *Arctocetraria andrejevii*, *Cetrariella delisei*, *Cladonia ecmocyna*, *C. crispata* and *C. stricta* in these heath patches distinctly shows their semi-moist character. *Cetraria islandica, Cladonia bellidiflora*, *C. chlorophaea*, *C. cornuta*, *C. cyanipes* and *Flavocetraria cucullata* preferably grow in more dry places in the heaths. It is a remarkable feature of the vegetation pattern of Qussuk that part of the above-mentioned lichens - and in particular *Cladonia stellaris* - forms almost pure lichen heaths covering up to fifty square metre! - *Cladonia stygia* often covers comparatively large areas in moist *Betula nana* heaths bordering bogs dominated by, for example, *Salix arctophila*. Transitions between these two communities contain lichens such as *Cladonia macrophyllodes*, *C. mitis*, *C. stygia* and *Peltigera malacea*.

Betula nana-Empetrum-Vaccinium-Ledum palustre heaths developed on more dry ground on hills differ considerably from the above-mentioned heath types as regards their content of lichens. *Flavocetraria nivalis* often is dominant, while the following lichens occur less abundantly: *Alectoria nigricans*, *A. ochroleuca*, *Bryocaulon divergens*, *Cetraria islandica*, *C. muricata*, *C. nigricans*, *Cladonia borealis*, *C. gracilis*, *C. mitis, Ochrolechia frigida, Pertusaria dactylina, Sphaerophorus globosus*, *Stereocaulon alpinum* and *Thamnolia vermicularis* (v. *subuliformis*). Relatively small fell-field patches with few and scattered dwarf shrubs, but abundant occurrences of the above-mentioned lichens can be found in windswept areas around Qussuk. Species such as *Cladonia stellaris* and *C. stygia* avoid places exposed to strong desiccation caused by wind (Hansen, 1971).

3. Sangujaarssuit

At the head of this fjord terricolous lichens appear to be of great importance in the following plant communities: open thickets composed of *Alnus crispa* or *Salix glauca*, dwarf shrub heaths, fell-fields and snowbeds. The first two communities are best developed in the lowland, while the last-mentioned communities preferably occurs at higher elevations.

The bottom layer in the scrubs is rich in mosses, for example, *Hylocomium splendens* and *Pleurozium schreberi*. A number of lichens are, however, favoured by the somewhat shady and moist conditions prevailing in this biotope, for example, *Nephroma arcticum, N. expallidum, Peltigera canina*, *P. didactyla*, *P. kristinssonii*,. *P. leucophlebia* and *P. malacea*. Occasionally, *Icmadophila ericetorum* and *Omphalina hudsoniana* are found growing over mosses on boggy ground together with Equisetum sylvaticum along the border of the scrubs.

Together with *Betula nana*, *Empetrum, Ledum groenlandicum, Salix glauca* and *Vaccinium* form heath mosaics, which generally are higher (> 50 cm) than those occurring at Qussuk. They also differ to some extent with regard to the lichen flora. *Cladonia mitis*, *C. stellaris* and *C. stygia* occur more rarely, whereas lichens such as *Buellia papillata* and *Nephroma expallidum* are relatively common in the heaths at Sangujaarssuit. Clayey frost boils occur abundantly at this locality. They are colonised by the following lichens: *Cladonia chlorophaea*, *C. mitis*, *C. phyllophora*, *C. pyxidata*, *Ochrolechia frigida*, *Peltigera didactyla*, *P. rufescens*, *Psoroma hypnorum* and *Stereocaulon alpinum*,.

An interesting *Salix herbacea-Sibbaldia procumbens* snowbed rich in lichens was found at c. 400 m a.s.l. on the mountain at the head of the fjord. Here the following lichens were noted: *Cetraria islandica*, *Cetrariella delisei*, *C. bellidiflora*, *C. borealis*, *C. crispata*, *C. ecmocyna*, *C. mitis*, *C. pleurota*, *C. sulphurina*, *Lepraria neglecta*, *Peltigera malacea*, *Pertusaria oculata*, *Solorina crocea*, *Stereocaulon alpinum* (dominant) and *S. paschale*. Large growths of *Solorina crocea* occur in similar north-facing places on this mountain.

C. Saxicolous flora

1. Qeqertarsuatsiaat

Nitrophilous lichen vegetation is widely distributed at Qeqertarsuatsiaat, but different lichen communities occurring on rocks without visible influence of guano or other nitrogenous matters are also of great importance. An iron-containing rock situated to the south of the town has a very characteristic lichen flora. The lichen vegetation on wind-swept boulders differ markedly from that associated with more protected boulders. The total number of epilithic lichens is larger at Qeqertarsuatsiaat than at the two other localities investigated (Table I).

A north-facing, vertical and strongly weathered siliceous rock situated on the southern outskirts of the town appears to be particular rich in saxicolous lichens. Part of the rock is distinctly influenced by guano of ravens and gulls. These patches support a number of ornithocoprophilous lichens such as *Aspicilia caesiocinerea*, *Candelariella vitellina*, *Diploschistes scruposus*, *Phaeophyscia sciastra*, *Physcia caesia*, *P. dubia*, *Protoparmelia badia*, *Rhizocarpon geminatum* and *Xanthoria elegans* (dominant). *Lecanora intricata*, *L. polytropa* and *Lecidea lapicida* v. *pantherina* are more or less common, too. Moist faces are covered by *Bellemerea cinereorufescens*, *Caloplaca nivalis*, *Cystocoleus ebeneus*, *Lecanora chloroleprosa*, *Placynthium asperellum*, *Rhizocarpon badioatrum*, *R. lavatum*, *Umbilicaria vellea* (dominant), *U. virginis* and *Xanthoria sorediata*. *Bellemerea cinereorufescens*, which is often found growing on metalliferous rocks (Wirth, 1995), forms an association with *Acarospora sinopica*, *A. smaragdula Lecidea lapicida*, *Porpidia melinodes* and *Tremolecia atrata* on rocks composed of amphibolite. Three different ecotypes of *A. smaragdula* occur at Qeqertarsuatsiaat, viz. the normal ecotype with pale brown thallus, a rust-stained ecotype and a green, possibly Cu-rich ecotype (Purvis & Halls, 1996). The occurrence of *Lecanora marginata* on the investigated rocks indicates presence of Ca (Hansen, 1995b).

Gneissic boulders occurring along the shore often have a bright yellow colour due to the dominant lichen *Candelariella arctica*. *Acarospora molybdina*, *Amandinea coniops*, *Caloplaca alcarum*, *C. fraudans*, *Lecanora contractula*, *L. straminea* and *Physcia tenella* v. *marina* are additional members of this community, which is favoured by guano of, for example, gulls, and by fish offal, too. *Candelariella arctica* is also common on blocks, which occur scattered in the town. *Verrucaria degelii* was found growing on gneissic rocks in the littoral zone along the coast at the northwestern part of Qeqertarsuatsiaat.

Blocks exposed to strong winds support lichens such as *Ophioparma ventosa, Tephromela aglaea* and *T. armeniaca*. They usually form a characteristic association together with *Aspicilia mastoidea* (sometimes replacing Orphniospora as the dominant lichen), *Orphniospora moriopsis* (often dominant), *Rhizocarpon inarense* and different species of *Umbilicaria*, for example, *U. hyperborea* and *U. torrefacta*. *Umbilicaria cinereorufescens* and *U. polyphylla*, both of which have a particular preference for inland areas (Hansen, 1971), were found growing on a strongly weathered, gneissic in a sheltered area southwest of Qeqertarsuatsiaat.

2. Qussuk

The following three types of epilithic lichen vegetation are of primary importance in the Qussuk area: lichen vegetation on dry, gneissic rocks without influence of nitrogenous matters, ornithocoprophilous lichen vegetation and lichen associations on rocks temporarily moistened by seeping water. Rust-stained lichens are, however, comparatively rare at Qussuk.

Orphniospora moriopsis is the dominant epilithic lichen some distance away from the coast. The species forms characteristic mosaics together with numerous macro- and microlichens. *Arctoparmelia centrifuga*, *A. incurva*, *Cetraria hepatizon*, *Parmelia saxatilis*, *Pseudephebe minuscula*, *P. pubescens*, *Sphaerophorus fragilis*, *Umbilicaria havaasii*, *U. hyperborea*, *U. proboscidea* and *U. torrefacta* are the most important macrolichens, and *Rhizocarpon geographicum*, *R. inarense*, *R. praebadium* and *R. rittokense* appear to be the most essential microlichens. The community, which is best developed on horizontal and slightly sloping surfaces of rocks and boulders, is widely distributed in Greenland (Hansen, 1978a, 1997). *Rhizocarpon eupetraeum*, which has a scattered occurrence at Qussuk, also belongs to this community. It has previously been reported from Narssaarssuaq and has a distinctly southern distribution in Greenland (Hansen, 1978b).

Exposed siliceous boulders near the coast and on the top of hills are often covered by a conspicuous ornithocoprohilous vegetation composed of the following species: *Candelariella vitellina, Melanelia disjuncta, Parmelia sulcata*, *Phaeophyscia sciastra*, *Physcia caesia*, P. dubia, *Umbilicaria arctica* (dominant), *Xanthoria borealis* and *X. elegans*. *Candelariella arctica* is dominant on seashore rocks manured by birds (Hansen, 1993).

Seepage rocks occur scattered in the lowland at Qussuk. They support lichens such as *Ephebe hispidula*, *Leprocaulon subalbicans*, *Massalongia carnosa, Polychidium muscicola, Umbilicaria deusta* and *Vestergrenopsis isidiata*. The three last-mentioned lichens usually grow on mosses, for example, *Andraea*, on such rocks (Hansen, Poelt & Søchting, 1987). *Caloplaca castellana* and *Placynthium asperellum* grow on sligtly manured, moist rocks. *Hymenelia lacustris* is restricted to rocks bordering glacial streams. Although a few rust-stained lichens, for example, *Acarospora sinopica*, *Miriquidica atrofulva* and *Tremolecia atrata*, were noted, this group of lichens is generally weakly represented at Qussuk.

3. Sangujaarssuit

The saxicolous lichen flora of the Sangujaarssuit area differs from that of Qeqertarsuatsiaat and Qussuk by the presence of a distinct southern inland-element represented by species such as *Lasallia pensylvanica, Lobaria scrobiculata* and *Nephroma bellum* (Hansen, 1995a) and by the lack of lichens occurring on seashore rocks. Otherwise, the lichen vegetation comprises of the same communities as those reported from Qeqertarsuatsiaat and Qussuk.

Vertical, mossy surfaces of small gneissic boulders situated in open *Salix glauca* scrubs are colonized by *Nephroma bellum* (dominant), *N. parile*, *Peltigera collina*, *Phaeophyscia endococcina* and *Psoroma hypnorum*. The last-mentioned species is usually found growing on rocks and boulders near watercourses and on seepage surfaces (Moberg & Hansen, 1986). Together with *Cetraria hepatizon*, *Lasallia pensylvanica* forms large growths on the top of big boulders in these lowland scrubs. L. pensylvanica also occurs abundantly on exposed rocks on the basal part of the mountains. Here it forms a characteristic association with *Arctoparmelia centrifuga*, *A. incurva, Orphniospora moriopsis. Umbilicaria cinereorufescens*, *U. cylindrica*, *U. havaasii*, *U. hyperborea* and *U. torrefacta. Aspicilia mastrucata*, *Pseudephebe minuscula*, *Rhizocarpon eupetraeum, R. grande*, *R. praebadium*, *R. rittokense* are additional important lichens on projecting rocks. Rocks exposed to strong winds support lichens such as *Ophioparma ventosa, Tephromela aglaea* and *T. armeniaca.* Moist rocks are covered by lichens such as *Amygdalaria panaeola*, *Lecanora chloroleprosa*, *Miriquidica atrofulva, Porpidia flavicunda*, *Rhizocarpon badioatrum*, *Tremolecia atrata Umbilicaria deusta* and *U. vellea*,.

A comparatively rich lichen flora is found on rocks manured by birds. *Xanthoria elegans*, *X. borealis*, *Physcia dubia*, *Parmelia sulcata*, *Hypogymnia austerodes*, *H. subobscura* and *Bryoria chalybeiformis* are more or less common macrolichens on such rocks, while *Protoparmelia badia*, *Aspicilia caesiocinerea*, *Dimelaena oreina*, *Rhizocarpon geminatum* and *R. bolanderi* appear to be the most important microlichens. *Xanthoria elegans* also grows on old bones, sometimes together with *Caloplaca cerina*, *C. tiroliensis* and *Lecanora behringii*. *Leptogium saturninum*, *Lobaria scrobiculata* and *Physconia detersa* were found growing in a fissure in a rock influenced by guano.

List of lichens and lichenicolous fungi

The lichens and lichenicolous fungi represented by the author´s collections are listed alphabetically. The list shows the locality for each of the 229 taxa collected (Fig. 1). Nomenclature follows mainly Santesson (1993). Information about the ecology of the lichens is also collocated in the list. The following abbreviations are used: ap = apothecia present; pe = perithecia present; st = sterile specimen; + = present; c = corticolous; t = terricolous; s = saxicolous; I = Qeqertarsuatsiaat/Fiskenæsset; II = Qussuk; III = area near the head of Sangujaarssuit; E = ecology.

Thirty-six numbers of lichens from the three localities have been distributed previously from herb C as part of "Lichenes Groenlandici Exsiccati", edited by the present author. The relevant numbers are stated in the following list.

	I	II	III	E
Acarospora molybdina (Wahlenb.) A. Massal.	ap			s
Acarospora peliscypha Th. Fr.	ap	ap		s
Acarospora rhizobola (Nyl.) Alstrup	st			t
Acarospora sinopica (Wahlenb.) Körb.	ap	st		s
Acarospora smaragdula (Wahlenb.) A. Massal.	ap			s
Alectoria nigricans (Ach.) Nyl.	st	st	st	t
Alectoria ochroleuca (Hoffm.) A. Massal.	st 556	st	st	t
Alectoria sarmentosa (Ach.) Ach. ssp. vexillifera (Nyl.) D. Hawksw.	st			t
Allantoparmelia alpicola (Th. Fr.) Essl.	ap	ap		s
Amandinea coniops (Wahlenb.) Scheid.	ap			s
Amygdalaria panaeola (Ach.) Hertel & Brodo		st	st	s
Arctocetraria andrejevii (Oxner) Kärnefelt & Thell	st	st 669		t
Arctoparmelia centrifuga (L.) Hale	ap	ap	ap	s
Arctoparmelia incurva (Pers.) Hale	st	st	st	s
Arthopyrenia punctiformis (Pers.) A. Massal.			ap	c
Arthrorhaphis alpina (Schaer.) R. Sant.	ap		st	t
Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold	ap	ap	ap	s
Aspicilia mastrucata (Wahlenb.) Th. Fr.	ap	ap	ap	s
Baeomyces placophyllus Ach.	st			t
Baeomyces rufus (Huds.) Rebent.	ap	ap	ap	t
Bellemerea cinereorufescens (Ach.) Clauzade & Cl. Roux	ap			s
Biatora vernalis (L.) Fr.	ap		ap	t
Brodoa oroarctica (Krog) Goward	ap	ap	st	s
Bryocaulon divergens (Ach.) Kärnefelt	st	st 673	st	t
Bryonora castanea (Hepp) Poelt		ap		t
Bryonora curvescens (Mudd) Poelt	ap			t
Bryoria chalybeiformis (L.) Brodo & D. Hawksw.	st	st	st	t
Bryoria nitidula (Th. Fr.) Brodo & D. Hawksw.		st	st	t
Buellia papillata (Sommerf.) Tuck.		ap	ap	t
Caloplaca alcarum Poelt	ap			s
Caloplaca ammiospila (Wahlenb.) H. Olivier	ap			t
Caloplaca castellana (Räsänen) Poelt		ap	ap	s
Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr.		ap	ap	-
Caloplaca fraudans (Th. Fr.) H. Olivier	ap			s
Caloplaca holocarpa (Hoffm. ex Ach.) A. E. Wade			ap	c
Caloplaca nivalis (Körb.) Fr.	ap			s
Caloplaca tiroliensis Zahlbr.			ap	t
Candelariella arctica (Körb.) R. Sant.	ap			s
Candelariella aurella (Hoffm.) Zahlbr.		ap		s
Candelariella placodizans (Nyl.) H. Magn.	st	st	st	t
Catapyrenium lachneum (Ach.) R. Sant.		pe		t
Cetraria commixta (Nyl.) Th. Fr.			ap	s
Cetraria hepatizon (Ach.) Vain.	ap 546	st	ap	s
Cetraria islandica (L.) Ach.	st 547	st	st	t
Cetraria muricata (Ach.) Eckfeldt	st	st	st	t
Cetraria nigricans Nyl.	st	ap	st	t
Cetraria sepincola (Ehrh.) Ach.		ap	ap	c
Cetrariella delisei (Bory ex Schaer.) Kärnefelt & Thell	ap	ap	st	t

Cladonia amaurocraea (Flörke) Schaer.	st	st	st	t
Cladonia arbuscula (Wallr.) Flot.	st			t
Cladonia bellidiflora (Ach.) Schaer.	ap	ap	st	t
Cladonia borealis S. Stenroos	ap	ap	ap	t
Cladonia cariosa (Ach.) Spreng.			ap	t
Cladonia carneola (Fr.) Fr.	ap	st		t
Cladonia cervicornis (Ach.) Flot. ssp. verticillata (Hoffm.) Ahti		st		t
Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.	st	st	ap	t
Cladonia cornuta (L.) Hoffm.	ap	st 654	st	t
Cladonia crispata (Ach.) Flot.	st	ap 655		t
Cladonia cyanipes (Sommerf.) Nyl.	st	st	st	t
Cladonia deformis (L.) Hoffm.		st	st	t
Cladonia ecmocyna Leight.	ap	ap 656	st	t
Cladonia fimbriata (L.) Fr.		st		t
Cladonia floerkeana (Fr.) Flörke	ap			t
Cladonia gracilis (L.) Willd.	ap	ap	st	t
Cladonia luteoalba Wheldon & A. Wilson		st		t
Cladonia macrophylla (Schaer.) Stenh.		ap	st	t
Cladonia macrophyllodes Nyl.	ap			t
Cladonia mitis Sandst.	ap	st 677	st	t
Cladonia phyllophora Hoffm.	st	ap	ap	t
Cladonia pleurota (Flörke) Schaer.	ap	ap	st	t
Cladonia pocillum (Ach.) Grognot	st			t
Cladonia pyxidata (L.) Hoffm.	st 554	st	ap 667	t
Cladonia squamosa Hoffm.	st	st	st	t
Cladonia stellaris (Opiz) Pouzar & Vezda	st	st 652	st	t
Cladonia stricta (Nyl.) Nyl.		ap 658		t
Cladonia stygia (Fr.) Ruoss	st	st 653	st	t
Cladonia subfurcata (Nyl.) Arnold		ap		t
Cladonia sulphurina (Michx.) Fr.	st	st	st	t
Cladonia uncialis (L.) Weber ex F. H. Wigg.	st	ap		t
Cystocoleus ebeneus (Dillwyn) Thwaites	st			s
Dibaes baeomyces (L. f.) Rambold & Hertel			st	t
Dimelaena oreina (Ach.) Norman			ap	s
Diploschistes scruposus (Schreb.) Norman	ap			s
Ephebe hispidula (Ach.) Horw.	st	st		s
Epilichen scabrosus (Ach.) Clem.	ap		ap	-
Euopsis pulvinata (Schaer.) Vain.		ap		s
Flavocetraria cucullata (Bellardi) Kärnefelt & Thell	st	st	st	t
Flavocetraria nivalis (L.) Kärnefelt & Thell	ap	ap	st	t
Graphium aphthosae Alstrup & D. Hawksw.			+	-
Hymenelia lacustris (With.) M. Choisy	ap	ap		s
Hypogymnia austerodes (Nyl.) Räsänen			st	s
Hypogymnia physodes (L.) Nyl.	st			s
Hypogymnia subobscura (Vain.) Poelt			st	s
Icmadophila ericetorum (L.) Zahlbr.			ap 662	t
Lasallia pennsylvanica (Hoffm.) Llano			ap 668	s
Lecanora atrosulphurea (Wahlenb.) Ach.	ap	ap		s
Lecanora behringii Nyl.			ap	-
Lecanora chloroleprosa (Vain.) H. Magn.	st	st	st	s
Lecanora contractula Nyl.	ap			s
Lecanora fuscescens (Sommerf.) Nyl.	ap	ap	ap	c
Lecanora intricata (Ach.) Ach.	ap	ap		s
Lecanora leucococca Sommerf.			ap	-
Lecanora marginata (Schaer.) Hertel & Rambold	ap			s
Lecanora polytropa (Ehrh. ex Hoffm.) Rabenh.	ap	ap	ap	s

Lecanora straminea Ach.	st			s
Lecanora symmicta (Ach.) Ach.			ap	c
Lecidea auriculata Th. Fr.		ap		s
Lecidea caesioatra Schaer.	ap			s
Lecidea lapicida (Ach.) Ach. v. lapicida	ap	ap	ap	s
Lecidea lapicida (Ach.) Ach. v. pantherina Ach.	ap			s
Lecidoma demissum (Rutstr.) Gotth. Schneid. & Hertel		ap	ap	t
Lepraria neglecta (Nyl.) Lettau	+	+	+	t
Leprocaulon subalbicans (I. M. Lamb) I. M. Lamb & A.M.Ward	+	+	+	t
Leproloma vouauxii (Hue) J. R. Laundon	+			s
Leptogium lichenoides (L.) Zahlbr.	st		st	t
Leptogium saturninum (Dicks.) Nyl.			st	s
Lobaria scrobiculata (Scop.) DC.			st	s
Massalongia carnosa (Dicks.) Körb.	st	st	st 665	s
Melanelia disjuncta (Erichsen) Essl.	st	st	st	s
Melanelia infumata (Nyl.) Essl.	st		st	s
Melanelia septentrionalis (Lynge) Essl.			ap 660	c
Miriquidica atrofulva (Sommerf.) A. J. Schwab & Rambold	st	st	st	s
Miriquidica nigroleprosa (Vain.) Hertel & Rambold		ap		s
Mycobilimbia lobulata (Sommerf.) Hafellner		ap	ap	t
Nephroma arcticum (L.) Torss.	st	st	st 664	t
Nephroma bellum (Spreng.) Tuck.			ap 661	s
Nephroma expallidum (Nyl.) Nyl.			st	t
Nephroma isidiosum (Nyl.) Gyeln.		st		s
Nephroma parile (Ach.) Ach.			st	s
Ochrolechia frigida (Sw.) Lynge	ap	ap	ap	t
Ochrolechia grimmiae Lynge	ap	ap	st	t
Ochrolechia lapuënsis (Räsänen) Räsänen	ap	ap	st	t
Ochrolechia tartarea (L.) A. Massal.	ap		st	s
Omphalina hudsoniana (H. S. Jenn.) H. E. Bigelow	+	+	+	t
Ophioparma ventosa (L.) Norman	ap	ap	ap	s
Orphniospora moriopsis (A. Massal.) D. Hawksw.	ap	ap	ap	s
Pannaria pezizoides (Weber) Trevis.	ap			t
Parmelia omphalodes (L.) Ach.	st	st	st	s
Parmelia saxatilis (L.) Ach.	ap	st 672	ap	s
Parmelia sulcata Taylor	st	st	st	s
Parmeliopsis ambigua (Wulfen) Nyl.		st	st	c
Parmeliopsis hyperopta (Ach.) Arnold		st	st	c
Peltigera aphthosa (L.) Willd.	ap	st	ap 659	t
Peltigera canina (L.) Willd.	ap		st	t
Peltigera collina (Ach.) Schrad.			st	s
Peltigera didactyla (With.) J. R. Laundon	st	st	st	t
Peltigera kristinssonii Vitik.			ap	t
Peltigera leucophlebia (Nyl.) Gyeln.	ap	st	ap	t
Peltigera malacea (Ach.) Funck	ap	st	ap	t
Peltigera rufescens (Weiss) Humb.	st		st	t
Peltigera scabrosa Th. Fr.	ap 548	ap		t
Pertusaria carneopallida (Nyl.) Anzi			ap	c
Pertusaria coriacea (Th. Fr.) Th. Fr.	ap			t
Pertusaria dactylina (Ach.) Nyl.		st	st	t
Pertusaria geminipara (Th. Fr.) C. Knight ex Brodo	st	st	st	t
Pertusaria glomerata (Ach.) Schaer.		ap		t
Pertusaria oculata (Dicks.) Th. Fr.	st	st	st	t
Pertusaria panyrga (Ach.) A. Massal.		ap	ap	t
Phaeocalicium compressulum (Szatala) Alb. Schmidt			ap	c
Phaeophyscia endococcina (Körb.) Moberg			ap	s

Phaeophyscia sciastra (Ach.) Moberg	st	ap	st	s
Phylliscum demangeonii (Moug. & Mont.) Nyl.		ap		s
Physcia caesia (Hoffm.) Fürnr.	ap	st	st	s
Physcia dubia (Hoffm.) Lettau	st	st 671	st	s
Physcia tenella (Scop.) DC. v. marina (A. Nyl.) Lynge	st			s
Physconia detersa (Nyl.) Poelt			st	s
Physconia muscigena (Ach.) Poelt	st			t
Placopsis gelida (L.) Linds.	st		st	s
Placynthium asperellum (Ach.) Trevis.	st	ap	st	s
Polychidium muscicola (Sw.) Gray		ap 674	st	s
Porpidia crustulata (Ach.) Hertel & Knoph			ap	s
Porpidia flavicunda (Ach.) Gowan	ap		ap	s
Porpidia melinodes (Körb.) Gowan & Ahti	st 550	st 670		s
Protoparmelia badia (Hoffm.) Hafellner	ap	ap	ap	s
Pseudephebe minuscula (Nyl. ex Arnold) Brodo & D. Hawksw.	ap	st	st	s
Pseudephebe pubescens (L.) M. Choisy	st	st 676	st	s
Psora rubiformis (Ach.) Hook.	ap			t
Psoroma hypnorum (Vahl) Gray	ap	ap	ap	t
Rhagadostoma lichenicola (De Not.) Keissl.		pe	pe	-
Rhizocarpon badioatrum (Flörke ex Spreng.) Th. Fr.	ap		ap	s
Rhizocarpon bolanderi (Tuck.) Herre			ap	s
Rhizocarpon disporum (Nägeli ex Hepp) Müll. Arg.	ap			s
Rhizocarpon eupetraeum (Nyl.) Arnold		ap	ap	s
Rhizocarpon geminatum Körb.	ap	ap	ap	s
Rhizocarpon geographicum (L.) DC.	ap	ap	ap	s
Rhizocarpon grande (Flörke) Arnold		ap	ap	s
Rhizocarpon inarense (Vain.) Vain.	ap			s
Rhizocarpon lavatum (Fr.) Hazsl.	ap			s
Rhizocarpon leptolepis Anzi			ap	s
Rhizocarpon praebadium (Nyl.) Zahlbr.	ap	ap	ap	s
Rhizocarpon rittokense (Hellb.) Th. Fr.		ap	ap	s
Rinodina cacuminum (Th. Fr.) Malme	ap	ap		s
Rinodina lecideoides (Nyl.) Kernst.			ap	c
Rinodina turfacea (Wahlenb.) Körb.	ap		ap	t
Solorina crocea (L.) Ach.	ap	ap	ap 663	t
Sphaerophorus fragilis (L.) Pers.	st	st	st	s
Sphaerophorus globosus (Huds.) Vain.	st	st	st	t
Stereocaulon alpinum Laurer	st	st	st	t
Stereocaulon arenarium (Savicz) I. M. Lamb	st			t
Stereocaulon botryosum Ach.	st	st	st	s
Stereocaulon glareosum (Savicz) H. Magn.	st			t
Stereocaulon paschale (L.) Hoffm.	st	st 657	st	t
Stereocaulon rivulorum H. Magn.	ap		st	t
Stereocaulon spathuliferum Vain.			st	s
Stereocaulon vesuvianum Pers.	st	st 678		s
Tephromela aglaea (Sommerf.) Hertel & Rambold	ap 555			s
Tephromela armeniaca (DC.) Hertel & Rambold	st		ap	s
Thamnolia vermicularis (Sw.) Schaer.	+	+	+	t
Toninia cumulata (Sommerf.) Th. Fr.	ap			t
Trapeliopsis granulosa (Hoffm.) Lumbsch		st	ap 666	t
Tremolecia atrata (Ach.) Hertel	ap	ap		s
Umbilicaria arctica (Ach.) Nyl.	ap	ap	ap	s
Umbilicaria cinereorufescens (Schaer.) Frey	st 549		st	s
Umbilicaria cylindrica (L.) Delise ex Duby	ap	ap	ap	s
Umbilicaria deusta (L.) Baumg.	st 553	st	st	s
Umbilicaria havaasii Llano	ap	ap 679	ap	s

Umbilicaria hyperborea (Ach.) Hoffm.	ap	ap	ap	s
Umbilicaria polyphylla (L.) Baumg.	st			s
Umbilicaria proboscidea (L.) Schrad.	ap	ap	ap	s
Umbilicaria rigida (Du Rietz) Frey	ap			s
Umbilicaria torrefacta (Lightf.) Schrad.	ap	ap	ap	s
Umbilicaria vellea (L.) Hoffm.	st	st	st	s
Umbilicaria virginis Schaer.	ap	ap		s
Varicellaria rhodocarpa (Körb.) Fr.		ap	ap	c
Verrucaria degelii R. Sant.	pe			s
Vestergrenopsis isidiata (Degel.) E. Dahl		st	st	s
Xanthoria borealis R. Sant. & Poelt	ap	ap	ap	s
Xanthoria elegans (Link) Th. Fr.	ap	ap	ap	s
Xanthoria sorediata (Vain.) Poelt	st			s

ACKNOWLEDGEMENTS

The author wish to thank the staff of the Greenland Institute of Natural Resources - in particular its director, Klaus Nygaard - and Mikkel Tamstorf, the National Environmental Research Institute, Department of Arctic Environment, for great help, hospitality and good company. I also wish to thank my other friends in Nuuk and Qussuk for their support in many ways. A grant from the Commision for Scientific Research in Greenland (KVUG) is gratefully acknowledged. Pipaluk Møller Lund and Arild Landa, the Greenland Institute of Natural Resources, Nuuk, and Ingvar Kärnefelt, Botanical Museum, Lund, kindly read and corrected the manuscript.

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MYCOTAXON

Volume LXXIV(2), pp. 447-462 April-June 2000

ISOZYME ANALYSIS OF DIFFERENT SPECIES OF THE GENUS SACCOBOLUS (ASCOMYCETES, PEZIZALES)

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ABSTRACT

In this work we accomplished the isozyme analysis of monosporic strains of ten species of the genus ***Saccobolus,*** with the aim of establishing: the precise identification of some especies among which, the continuous variation of some characters poses doubts about their delimitation, interspecific relationships within the genus and evaluate possible intraspecific variations. No differences were observed in the state of the characters between the monosporic strains of each geographical isolate. Esterases was the only system in which differences between some geographical isolates were observed within the same species, resulting in a total of 15 band patterns. The phenogram obtained from grouping analysis (UPGMA) showed two groups of species, corresponding to the two sections of the genus. The isozyme analysis shows a very close degree of association within the members of the genus ***Saccobolus***, this agrees with the morphological and physiological observations of the group, in which the species are regarded as a continuum. In the species studied of the genus ***Saccobolus*** the scarce intraspecific variation (due probably to the type of sexual reproduction) allows to emphasise the interspecific differences and clearly separate the different species These scarce isoenzimatic variability, could reflect a real genetic homogeneity. The results of this research support the use of isozyme patterns of enzymes tested for the delimitation of species in the genus. This analysis warrants the existence of the ten species as taxonomically independent units.

Key words: isozymes, Ascobolaceae, taxonomy, fungi, ***Saccobolus***.

INTRODUCTION

The genus ***Saccobolus*** (Pezizales, Ascobolaceae) was established by Boudier (1869) and characterised by the presence of a mucilaginous hyaline sheath surrounding the ascospores which are grouped forming a pack inside the ascus. The genus is divided in two sections: ***Saccobolus*** and ***Eriobolus.*** In the first we find species with yellow, yellowish amber receptacles (lateral and exterior part of the apotecium, excluding the hymenium), and yellow-citrine, yellowish orange or orange yellowish content of the paraphyses. There is no amorphous intercellular pigment and the ascospore packing follows pattern I (van Brumelen, 1967). In the section ***Eriobolus*** we find species with white, violated pale or violated brown receptacles and hialine paraphyses. Usually an amorphous intercellular pigment is present in the end of the paraphysis and the ascospore packing follows pattern II and IV (van Brumelen, 1967).

We have found considerable coincidences in morphological, microscopic, cytological and developmental characters from the study of numerous isolates and cultures belonging to ascospores of different species of the genus ***Saccobolus***. Such coincidences have led us, in certain instances, to doubt in the delimitation of some species. Even though characteristics such as structure and asci dimensions, type of dehiscence, spores ornamentation and general pattern of ascocarp development have a clear importance in the classification of the species in the genus. In many cases, these have led to uncertainty in the identification of certain species, within which we observe a continuous variation of many characters.

Different authors have contributed to widen the knowlodge of the genus, van Brummelen (op. cit.), Carrol (1967), Gamundi and Ranalli (1969), Ranalli and Gamundi (1975), Ranalli and Forchiassin (1976), Mercuri and Forchiassin (1978), Forchiassin and Dokmetzian (1982), Forchiassin (1983), Galvagno et al. (1984), Dokmetzian et al. (1986), Mouso and Ranalli (1986), Ranalli and Gonzalez Castelain (1994), Ranalli et al. (1994), Ramos (1994), Ramos and Forchiassin (1996, a y b), Ranalli and Mercuri (1995), Zelada et al. (1994).

With the problem outlined and in order to clarify doubts, this work presents the isozyme analysis of 114 strains belonging to ten species of the ***Saccobolus***. The aim of the analysis is to establish the precise identification of the species, interspecific relationships within the genus and evaluate possible intraspecific variations.

MATERIALS AND METHODS

Organisms: Monosporic strains were used and kept in PF medium (Gamundi and Ranalli, 1964) at 5°C, BAFC: Buenos Aires Facultad de Ciencias Table 1

Table 1. List of strains

KEY	STRAINS	LOCATION	SUBSTRATE	DATE	BAFC #
CitER 1	*S. citrinus* **ER**	Gualeguaychú, ER,Arg	cow dung	Jan-88	2838
CitER 2	*S. citrinus* **ER**	Gualeguaychú, ER,Arg	cow dung	Jan-88	2839
CitER 3	*S. citrinus* **ER**	Gualeguaychú, ER,Arg	cow dung	Jan-88	2840
CitER 4	*S. citrinus* **ER**	Gualeguaychú, ER,Arg	cow dung	Jan-88	2841
CitER 5	*S. citrinus* **ER**	Gualeguaychú, ER,Arg	cow dung	Jan-88	2842
CitII 1	*S. citrinus* **I I**	Campana, PBA, Arg	cow dung	Apr-94	2826
CitII 3	*S. citrinus* **I I**	Campana, PBA, Arg	cow dung	Apr-94	2843
CitII 5	*S. citrinus* **I I**	Campana, PBA, Arg	cow dung	Apr-94	2844
CitFAC 1	*S. citrinus* **FAC**	Ciudad Universitaria, BA, Arg	cow dung	Apr-94	2827
CitFAC 3	*S. citrinus* **FAC**	Ciudad Universitaria, BA, Arg	cow dung	Apr-94	2845
CitFAC 5	*S. citrinus* **FAC**	Ciudad Universitaria, BA, Arg	cow dung	Apr-94	2846
Long 0	*S. longevisporus* **PD**	Puerto Deseado, SC, Arg	cow dung	Nov-83	2847
Long 1	*S. longevisporus* **PD**	Puerto Deseado, SC, Arg	cow dung	Nov-83	2848
Long 2	*S. longevisporus* **PD**	Puerto Deseado, SC, Arg	cow dung	Nov-83	2849
Long 3	*S. longevisporus* **PD**	Puerto Deseado, SC, Arg	cow dung	Nov-83	2850
Long 4	*S. longevisporus* **PD**	Puerto Deseado, SC, Arg	cow dung	Nov-83	2851
PlatAg 0	*S. platensis* **AG**	Agronomía, BA, Arg	cow dung	Jul-92	2852
PlatAg 2	*S. platensis* **AG**	Agronomía, BA, Arg	cow dung	Jul-92	2853
PlatAg 3	*S. platensis* **AG**	Agronomía, BA, Arg	cow dung	Jul-92	2854
PlatAg 5	*S. platensis* **AG**	Agronomía, BA, Arg	cow dung	Jul-92	2855
PlatSM 1	*S. platensis* **SM**	San Martín , N.Arg	horse dung	Jan-96	2856
PlatSM 2	*S. platensis* **SM**	San Martín , N.Arg	horse dung	Jan-96	2857
PlatSM 3	*S. platensis* **SM**	San Martín , N.Arg	horse dung	Jan-96	2858
PlatSM 4	*S. platensis* **SM**	San Martín , N.Arg	horse dung	Jan-96	2859
PlatSM 5	*S. platensis* **SM**	San Martín , N.Arg	horse dung	Jan-96	2860
PlatSP 0	*S. platensis* **SP**	San Pedro, PBA, Arg	cow dung	May-91	2861
PlatSP 1	*S. platensis* **SP**	San Pedro, PBA, Arg	cow dung	May-91	2862
PlatSP 2	*S. platensis* **SP**	San Pedro, PBA, Arg	cow dung	May-91	2863
PlatSP 3	*S. platensis* **SP**	San Pedro, PBA, Arg	cow dung	May-91	2864
PlatSP 5	*S. platensis* **SP**	San Pedro, PBA, Arg	cow dung	May-91	2865

Table 1. List of strains

KEY	STRAINS	LOCATION	SUBSTRATE	DATE	BAFC #
SaccBC 2	*S.saccoboloides* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-87	2596
SaccBC 3	*S.saccoboloides* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-87	2866
SaccBC 6	*S.saccoboloides* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-87	2867
SaccBC 7	*S.saccoboloides* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-87	2868
SaccBC 8	*S.saccoboloides* **BC**	Villla La Angostura, N, Arg	cow dung	Sep-88	2869
SaccT 3	*S.saccoboloides* **TAFI**	Tafi del Valle, T, Arg	cow dung	Sep-88	2822
SaccT 4	*S.saccoboloides* **TAFI**	Tafi del Valle, T, Arg	cow dung	Sep-88	2870
SaccT 6	*S.saccoboloides* **TAFI**	Tafi del Valle, T, Arg	cow dung	Sep-88	2871
Sacc Ez 9	*S.saccoboloides* **EZ**	Ezeiza, PBA, Arg	horse dung	Mar-94	2872
Sacc Ez 10	*S.saccoboloides* **EZ**	Ezeiza, PBA, Arg	horse dung	Mar-94	2873
Sacc Ez 11	*S.saccoboloides* **EZ**	Ezeiza, PBA, Arg	horse dung	Mar-94	2874
Sacc Ez 12	*S.saccoboloides* **EZ**	Ezeiza, PBA, Arg	horse dung	Mar-94	2875
Sacc Ez 13	*S.saccoboloides* **EZ**	Ezeiza, PBA, Arg	horse dung	Mar-94	2876
SuccSM 0	*S. succineus* **SM**	San Martín , RN.Arg	horse dung	Jan-96	2877
SuccSM 4	*S. succineus* **SM**	San Martín , RN.Arg	horse dung	Jan-96	2878
SuccSM 5	*S. succineus* **SM**	San Martín , RN.Arg	horse dung	Jan-96	2879
SuccSM 6	*S. succineus* **SM**	San Martín , RN.Arg	horse dung	Jan-96	2880
SuccSM 8	*S. succineus* **SM**	San Martín , RN.Arg	horse dung	Jan-96	2881
SuccV 0	*S. succineus* **ER**	Gualeguaychú, ER,Arg	cow dung	Apr-89	2882
SuccV 1	*S. succineus* **ER**	Gualeguaychú, ER,Arg	cow dung	Apr-89	2883
SuccV 2	*S. succineus* **ER**	Gualeguaychú, ER,Arg	cow dung	Apr-89	2884
SuccV 3	*S. succineus* **ER**	Gualeguaychú, ER,Arg	cow dung	Apr-89	2885
SuccV 4	*S. succineus* **ER**	Gualeguaychú, ER,Arg	cow dung	Apr-89	2886
TruncBC 2	*S. truncatus* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-97	2595
TruncBC 3	*S. truncatus* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-97	2887
TruncBC 4	*S. truncatus* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-97	2888
TruncBC 5	*S. truncatus* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-97	2889
TruncBC 6	*S. truncatus* **BC**	Villla La Angostura, N, Arg	cow dung	Jan-97	2890
TruncT 0	*S. truncatus* **T**	Tandil, PBA, Arg	horse dung	Jan-92	2821
TruncT 1	*S. truncatus* **T**	Tandil, PBA, Arg	horse dung	Jan-92	2891
TruncT 2	*S. truncatus* **T**	Tandil, PBA, Arg	horse dung	Jan-92	2892
TruncT 3	*S. truncatus* **T**	Tandil, PBA, Arg	horse dung	Jan-92	2893
TruncT 4	*S. truncatus* **T**	Tandil, PBA, Arg	horse dung	Jan-92	2894

Table 1. List of strains

KEY	STRAINS	LOCATION	SUBSTRATE	DATE	BAFC #
DepF 1	***S.depauperatus*** **FAC**	Ciudad Universitaria, BA, Arg	horse dung	Sep-94	2895
DepF 3	***S.depauperatus*** **FAC**	Ciudad Universitaria, BA, Arg	horse dung	Sep-94	2896
DepF 4	***S.depauperatus*** **FAC**	Ciudad Universitaria, BA, Arg	horse dung	Sep-94	2897
DepF 4'	***S.depauperatus*** **FAC**	Ciudad Universitaria, BA, Arg	horse dung	Sep-94	2898
Dep I 1	***S.depauperatus*** **II**	Campana, PBA, Arg	cow dung	Ago-94	2833
Dep I 2	***S.depauperatus*** **II**	Campana, PBA, Arg	cow dung	Ago-94	2811
Dep I 3	***S.depauperatus*** **II**	Campana, PBA, Arg	cow dung	Ago-94	2812
In AD 1	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2831
In AD 2	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2899
In AD 3	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2900
In AD 4	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2901
In AD 5	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2902
In AD 6	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2903
In AD 7	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2904
In AD 8	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2905
In AD 9	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2906
In AD 10	***S. infestans*** **AD**	Adrogué, PBA,Arg.	horse dung	Mar-91	2908
In PA 13	***S. infestans*** **PA**	Porto Alegre, Brasil	cow dung	May-91	2832
In PA 14	***S. infestans*** **PA**	Porto Alegre, Brasil	cow dung	May-91	2909
In PA 15	***S. infestans*** **PA**	Porto Alegre, Brasil	cow dung	May-91	2910
In PA 16	***S. infestans*** **PA**	Porto Alegre, Brasil	cow dung	May-91	2911
In PA 17	***S. infestans*** **PA**	Porto Alegre, Brasil	cow dung	May-91	2912
Seu I 2	***S.seudodepauperatus*** **II**	Campana, PBA, Arg	cow dung	Aug. 94	2913
Seu I 3	***S.seudodepauperatus*** **II**	Campana, PBA, Arg	cow dung	Aug. 94	2914
Seu I 4	***S.seudodepauperatus*** **II**	Campana, PBA, Arg	cow dung	Aug. 94	2915
Seu I 6	***S.seudodepauperatus*** **II**	Campana, PBA, Arg	cow dung	Aug. 94	2916
Seu I 8	***S.seudodepauperatus*** **II**	Campana, PBA, Arg	cow dung	Aug. 94	2917

Table 1. List of strains

KEY	STRAINS	LOCATION	SUBSTRATE	DATE	BAFC #
Seu V 2	*S.seudodepauperatus* **I V**	Campana, PBA, Arg	horse dung	Aug. 94	2828
Seu V 3	*S.seudodepauperatus* **I V**	Campana, PBA, Arg	horse dung	Aug. 94	2919
Seu V 4	*S.seudodepauperatus* **I V**	Campana, PBA, Arg	horse dung	Aug. 94	2920
Seu V 5	*S.seudodepauperatus* **I V**	Campana, PBA, Arg	horse dung	Aug. 94	2921
Seu V 6	*S.seudodepauperatus* **I V**	Campana, PBA, Arg	horse dung	Aug. 94	2922
Seu EZ 1	*S.seudodepauperatus* **EZ**	Ezeiza, PBA, Arg	horse dung	Jun-91	2829
Seu EZ 2	*S.seudodepauperatus* **EZ**	Ezeiza, PBA, Arg	horse dung	Jun-91	2923
Seu EZ 3	*S.seudodepauperatus* **EZ**	Ezeiza, PBA, Arg	horse dung	Jun-91	2924
Seu EZ 4	*S.seudodepauperatus* **EZ**	Ezeiza, PBA, Arg	horse dung	Jun-91	2925
Ver GC 0	*S.verrucisporus* **GC**	Gob.Castro,PBA, Arg	horse dung	Jun-83	2823
Ver GC 1	*S.verrucisporus* **GC**	Gob.Castro, PBA, Arg	horse dung	Jun-83	2926
Ver GC 2	*S.verrucisporus* **GC**	Gob.Castro, PBA, Arg	horse dung	Jun-83	2927
Ver GC 3	*S.verrucisporus* **GC**	Gob.Castro, PBA, Arg	horse dung	Jun-83	2928
Ver GC 4	*S.verrucisporus* **GC**	Gob.Castro, PBA, Arg	horse dung	Jun-83	2929
Ver GC 5	*S.verrucisporus* **GC**	Gob.Castro, PBA, Arg	horse dung	Jun-83	2930
Ver G 1	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2931
Ver G 2	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2932
Ver G 3	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2933
Ver G 4	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2934
Ver G 5	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2935
Ver G 6	*S.verrucisporus* **G**	Gualeguaychú, ER, Arg	cow dung	Apr-89	2936
Ver I I 6	*S.verrucisporus* **I I**	Campana, PBA, Arg	cow dung	Aug. 94	2937
Ver I I 7	*S.verrucisporus* **I I**	Campana, PBA, Arg	cow dung	Aug. 94	2938
Ver I I 8	*S.verrucisporus* **I I**	Campana, PBA, Arg	cow dung	Aug. 94	2939

shows the location (place, province) (BA: Buenos Aires, PBA: province of Buenos Aires, SC province of Santa Cruz, ER province of Entre Ríos, N: province of Neuquén, RN: province of Río Negro, T: province of Tucumán), substrate (dung), date of collection and strain number (BAFC #) for all the isolates.

Growth medium: $SO_4Mg.7H_2O$, 0,5g; PO_4H_2K, 0,5g; PO_4HK_2, 0,6g; $CuSO_4.5H_2O$, 0,4mg; $MnCl_2.4H_2O$ 0,09mg; H_3BO_3, 0,07mg; $Na_2MoO_4.2H_2O$, 0,02mg; $FeCl_3$, 1mg; $ZnCl_2$, 10mg; biotine 5µg; thiamine-HCL 0.1 mg., glucose 15 g., asparagine 4 g, distilled water to complete 1 litre.

Growth medium was sterilized at 121°C and 1.2 atm. for 20 minutes.

Erlenmeyer flasks containing 50 ml of fresh medium were inoculated by transferring a 5 mm disk cut out from the margin of a 5 day-old colony growing on 2% Bactoagar. Incubation was carried out at 24°C under continuous and orbital shaking at 125 r.p.m. in an New Brunswick G 27 incubator chamber.

Mycelium was harvested, vacuum filtered in a Buchner funnel through filter paper and dried at 90 °C to obtain dry weight values as a growth variable in time. For the samples used in the electrophoretic analysis, the mycelium was harvested the day of maximum growth (which was established for each species from growth curves) rinsed three times with bidistilled water, fractionated and kept at -70 °C until used. The mycelium was milled with extraction buffer (100mM Buffer Tris-HCl, pH 7,5, 0,1% v/v 2-mercaptoetanol, 1mM EDTA, 10mM ClK, 10mM $Cl_2Mg.6H_2O$, 10% PVP 10000) (Soltis et al., 1983), separated in aliquots and kept at -70°C until used.

Polyacrylamide gels and enzymatic dying: The horizontal gel technique was used, using gel concentrations of 7% polyacrylamide (Saidman, 1985). Buffer solutions for gel preparation varied according to the different isozyme system analysed. Thirteen enzymatic systems were analysed. The enzimatic system were clasified in:

Enzymes with good resolution for all isolates ACP (acid phosphatase) EC: 3.1.3.2, G6PD (glucose-6-phosphate dehydrogenase) EC: 1.1.1.49, IDH (isocitrate dehydrogenase) EC: 1.1.1.42, EST (esterase) EC: 3.1.1..., GOT (glutamic oxaloacetic transaminase) EC: 2.6.1.1, SOD (superoxide dismutase) EC: 1.15.1.1. Enzymes with good resolution for only some isolates AK (alkaline phosphatase) EC: 3.1.3.1, GDH (NADP) (glutamate dehydrogenase) EC: 1.4.1.3, MDH(NADP) (malate dehydrogenase (NADP)) EC: 1.1.1.40, MDH(NAD) (malate dehydrogenase (NAD)) EC: 1.1.1.37. Enzymes with poor or no resolution ADH (alcohol dehydrogenase) EC: 1.1.1.1, CAT (catalase) EC: 1.11.1.6, PER (peroxidase) EC: 1.11.1.7.

Different systems of gel buffer (A) and electrode gel (a) for each enzyme

were used:
(A) Lithium borate, pH 8 / (a) Lithium borate, pH 8,2 (Scandalios, 1969; modified); ADH, CAT, EST, GOT, MDH(NADP), MDH(NAD), SOD, PER.
(A) Tris-citrate, pH 6,5 / (a) Tris citrate, pH 7 (Selander et al., 1971; modified); ACP, AK, IDH, GDH (NADP).
(A)/(a) Tris citrate, pH 8 (Soltis et al., op. cit.); G6PD.

Dying techniques for AAT were performed according to Vallejos, (1983); for ACP, G6PD, AK, IDH, GDH (NADP), ADH, CAT, PER, were performed according to Manchenko (1994); and for EST, GOT, MDH(NADP), MDH(NAD), SOD according to Wendel and Weeden (1989). The six systems wich showed the best resolution for all the isolates were selected for the subsequent analysis.

The extracts were absorbed in Whatman 3 MM paper rectangles (2mm x 4mm), which were introduced in the grooves made in the gel.

They were then covered with a solution of bromophenol blue (which marked the front of the electrophoretic run).Electrophoresis was carried out at constant temperature, 4°C; using a potential difference of 120 volts. during 5 hours, after which we proceeded to reveal the different bands of enzymatic activity.

The distance for each band from the origin was measured in every enzymatic system. Rf was determined as the ratio between the migration distance of each band of enzymatic activity with respect to the bromophenol blue front.

Numerical methods: The 24 geographical isolates of the ten species of *Saccobolus* constituted the operative taxonomic units (OTU).

The characters used, each represented by a band of enzymatic activity, were obtained from studying the material detailed in table 1. Forty eight characters were used and entered in a phenetic matrix as binary data which were coded as presence (1) or absence (0) for all the monosporic isolates consigned in table 1. No differences were observed between the different monosporic strains from each geographical area, therefore we determined that each one was one operative taxonomic unit.

Grouping analysis: From the basic matrix the coefficient of similarity of Gower (Sneath and Sokal, 1973) was calculated for each possible OTU pair. The resulting matrix was analysed by the unweighted pair-group method using arithmetic averages (UPGMA) (Sneath and Sokal, op. cit..). The Multivariate Statistical Package (MVSP) programme (Kovack, 1993) was used in the analysis. The distortion produced during the grouping analysis was calculated using the coefficient of phenetic correlation, (Sokal and Rohlf, 1962) using the

NTSYS-PC (Rolf, 1993) programme.

RESULTS AND DISCUSSION

Figure 1 shows the diagrams of the zymograms for the six isozyme systems 44 electromophs were detected.

Acid phosphatase showed six different band patterns for both sections. Figure 1 (1-A-F).

The only system that showed some differences between the different geographical isolates for the same species was esterases figure 1 (2.A-O) showing a total of 15 band patterns. Among the species of the section ***Saccobolus***, ***S. longevisporus*** 2-C, ***S. platensis*** 2-D and ***S. truncatus*** 2-I did not show differences between different geographical isolates, whilst ***S. citrinus*** 2-A and B, ***S. saccoboloides*** 2-E and F and ***S. succineus*** 2-G and H did.

The section *Eriobolus* showed six band patterns for esterases (J-O). ***S depauperatus*** (2-J) and ***S. infestans*** (2-K) did not show differences between different isolates, while some isolates of ***S. seudodepauperatus*** (2-L y M) and ***S. verrucisporus*** (2-N y O) differed from the rest.

Glucose-6phosphate dehydrogenase figure 1 (3.A-E) showed three electromorphs, with one band each, for the section ***Saccobolus*** (3.A-C). and two for the section ***Eriobolus*** (3.D-E). Glutamic oxaloacetic transaminase figure 1 (4.A-F) showed only two electromorphs with one band for the section ***Saccobolus*** (4.A-B). The section ***Eriobolus*** showed one band pattern for each species (4.C-F).

Isocitrate dehydrogenase figure 1 (5.A-D) showed 4 electromorphs with two bands each. Two electromorphs for the section ***Saccobolus*** (5.A-B). and two for the section ***Eriobolus*** (5.C-D). Superoxide dismutase figure 1 (6.A-H) showed five band patterns for the species of the section ***Saccobolus*** (6-A a E), and three for the section ***Eriobolus*** (6-F a H).

Among the six isoenzimatic system studied, only the glucose-6-phosphate dehydrogenase showed one band for all the strains analysed, in concordance with haploid state of vegetative mycelium. The presence of simple bands due to the expression of simple alleles could be expected. The existance of multiple band patterns for some of the system investigated, suggests the existence of secondary enzymes, resulting from post-transductional processes, or expression of alleles of different loci. (Harris and Hopkinson, 1978 ; Micales, 1992)

The phenogram obtained from the grouping analysis (UPGMA) figure 2, shows that the two sections in which the genus is divided are clearly separated

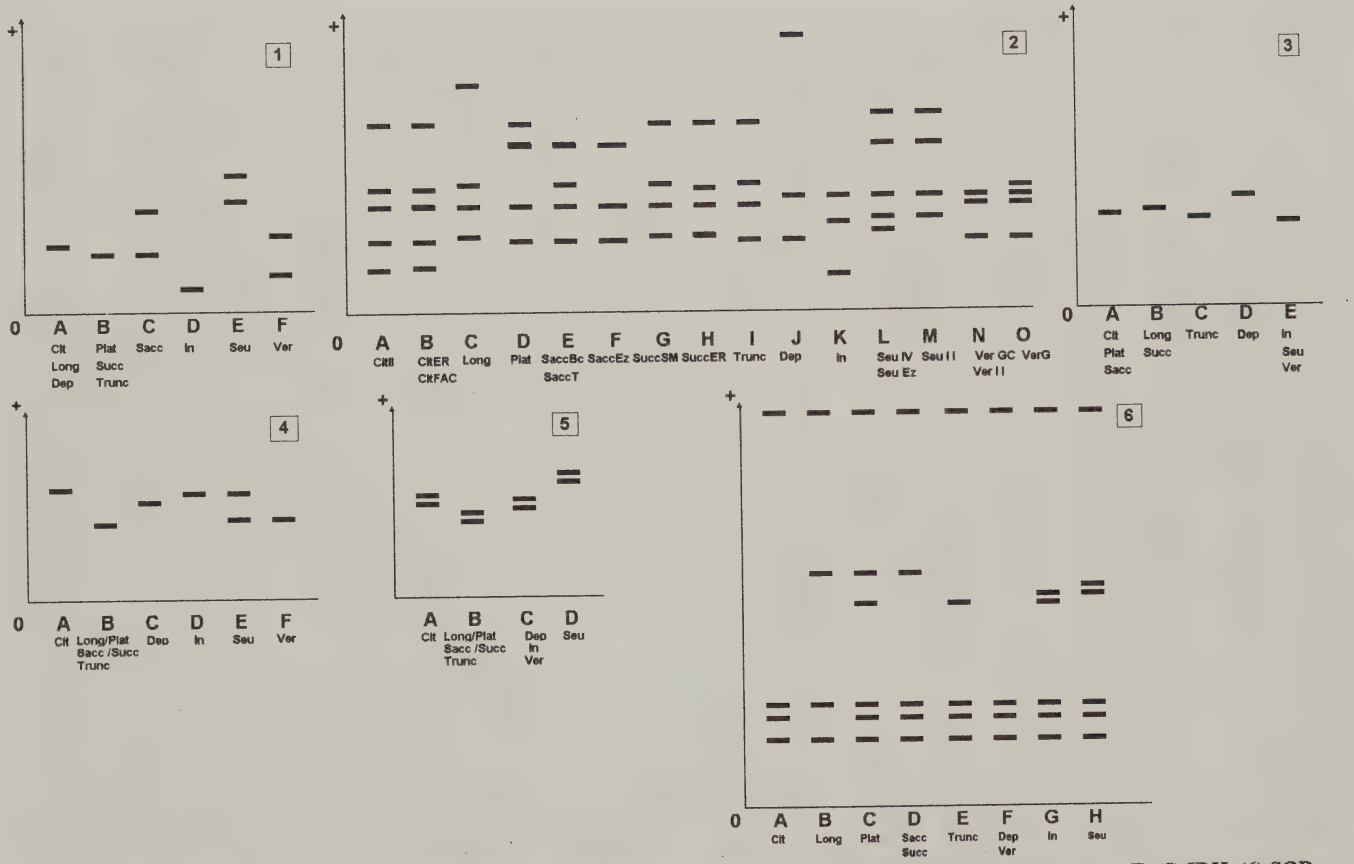
1
+
0
A Cit Long Dep
B Plat Succ Trunc
C Sacc
D In
E Seu
F Ver
2
+
0
A CitI
B CitER CitFAC
C Long
D Plat
E SaccBc SaccT
F SaccEz
G SuccSM
H SuccER
I Trunc
J Dep
K In
L Seu IV Seu Ez
M Seu I I
N Ver GC Ver I I
O VerG
3
+
0
A Cit Plat Sacc
B Long Succ
C Trunc
D Dep
E In Seu Ver
4
+
0
A Cit
B Long/Plat Sacc /Succ Trunc
C Dep
D In
E Seu
F Ver
5
+
A Cit
B Long/Plat Sacc /Succ Trunc
C Dep In Ver
D Seu
6
+
0
A Cit
B Long
C Plat
D Sacc Succ
E Trunc
F Dep Ver
G In
H Seu

Figure 1. Diagram of electromorphs (A - O) identified for each system: (1) ACP, (2)EST, (3) G6PDH, (4) AAT, (5) IDH, (6) SOD.

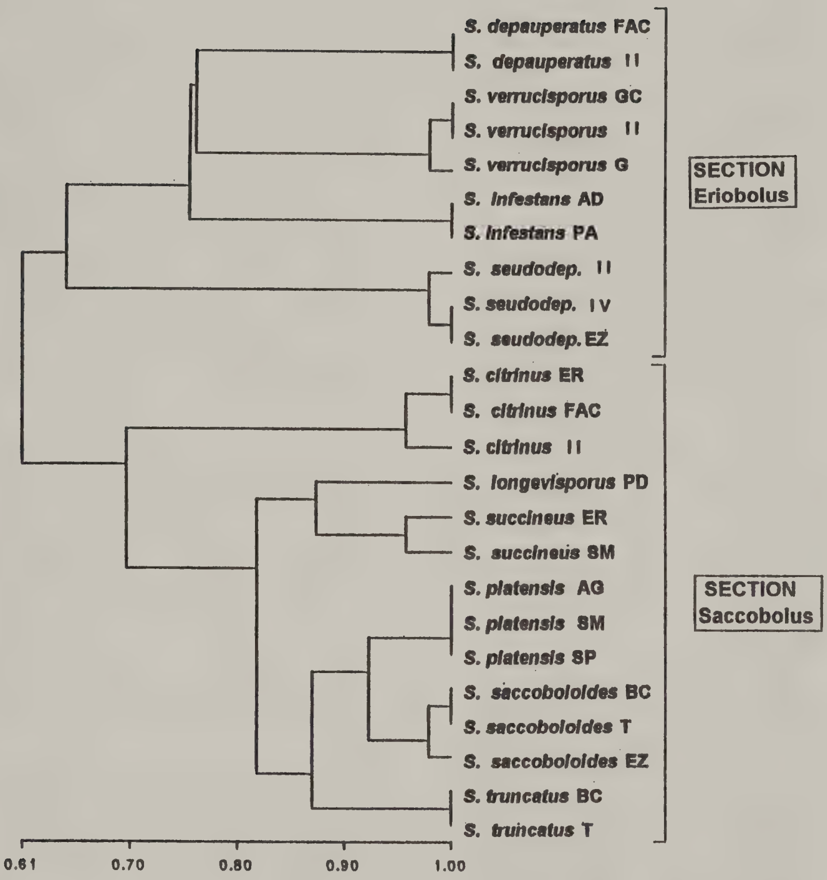
S. depauperatus FAC
S. depauperatus II
S. verrucisporus GC
S. verrucisporus II
S. verrucisporus G
S. infestans AD
S. infestans PA
S. seudodep. II
S. seudodep. IV
S. seudodep. EZ
S. citrinus ER
S. citrinus FAC
S. citrinus II
S. longevisporus PD
S. succineus ER
S. succineus SM
S. platensis AG
S. platensis SM
S. platensis SP
S. saccoboloides BC
S. saccoboloides T
S. saccoboloides EZ
S. truncatus BC
S. truncatus T
SECTION Eriobolus
SECTION Saccobolus
0.61
0.70
0.80
0.90
1.00

Figure 2. Phenogram based on Gower coefficient. UPGMA Cluster analysis.

in two groups of species. Each of these groups comprises the geographic isolates of the species previously included in each section. The core that contains the species of the section ***Eriobolus*** shows a subgroup of three species, ***S. depauperatus***, ***S. infestans*** and ***S. verrucisporus*** and one OTU, separated from the rest, represented by ***S. seudodepauperatus***. The other group, which includes an the species of the section ***Saccobolus,*** shows a group formed by five species: ***S. longevisporus***, ***S. succineus***, ***S. platensis***, ***S. saccoboloides*** and ***S. truncatus***; and another isolated from the rest formed by the populations of ***S. citrinus.*** In the first group two smaller groups are formed, one constituted by ***S. platensis S. saccoboloides*** and ***S.truncatus,*** and another one formed by ***S. longevisporus*** and ***S. succineus.***

The two groups which correspond to both sections, are associated with a degree of similarity greater then 60 %. The species showed scarce differences among the populations of the same species, with degree of similarity of around 100%, indicating that their phenotipes are almost identical. The differences of some bands for esterses cause the slight differences in the degree of similarity among the strains of different populations of the same species. The rest of the enzymes did not show differences among geographic isolates.

The coefficient of phenetic correlation was of 0,94 indicating hardly any distortion in the grouping analysis.

When numerous isolates of different species of the genus ***Saccobolus*** were studied, the coincidences observed in morphological, citological and developmental charaters poses doubts on their clear delimitation. On the other hand the growth media and culture conditions caused variations in the morphology of the apotecia and their distribution on the substrate, these changes can be observed not only in the laboratory but also in natural populations.

The isoenzymatic techniques utilized in this work clearly delimited the species of the genus. Each species showed characteristic band patterns for the majority of the isoenzymatic systems analyzed.

When comparing the results obtained from isoenzymatic analysis with previous morphological and physiological studies, we can observe that the higher degree of similarity between pairs of species is in concordance with greater similarities in morphological characters and physiological characteristics.

S. saccoboloides and ***S. platensis*** which showed the highest degree of similarity, are also species tightly tied when culture and morphological characters are analyzed (Ranalli y Mercuri, op. cit.).

S. citrinus, a species that clearly differs from the core or group that includes the rest of the species in the section ***Saccobolus*** in the isoenzymatic phenogram, presents a physiological and culture behaviour that differs notoriously from the rest, although such differences are not expressed in its morphology.

In the section ***Eriobolus*** the species are better morphologically delimited and this fact is reflected in the isoenzymatic analysis. ***S. seudodepauperatus*** was the species that showed the lowest degree of similarity. Ranalli y Gamundi, op. cit., analyzed culture and morphological characters to compare ***S. seudodepauperatus*** and ***S. depauperatus***. This study showed a clear difference between both species, as well as among ***S. seudodepauperatus*** and the rest of the species in the section.

With respect to the scarce variability that exists within of the species of this genus, it can be related to their type of sexual reproduction. All the species of the genus are homothallic; this means that they are able to complete their life cycle starting from a monosporic strain. It has been proposed that the degree of variation is in direct relationship with the degree of sexual reproduction in the population or species. In populations of ***Phakopsora pachyrhizi*** (Bonde et al., 1988) and ***Puccinia striiformis*** (Newton et al., 1985), pathogens which do not reproduce sexually, low levels of enzyme diversity were reported. Previously Burdon et al. (1983) reported that there was no genetic variation in the collections of ***Puccinia graminis f. sp. tritici*** from Australia when the fungi were forced to reproduce asexually. Harrington et al, op. cit., correlated the enzymatic variability with the type of reproduction in ***Ceratocystis***. In this genus, a scarce or null isoenzymatic variability in the homotallic species could be observed also in one species that only has asexual reproduction, while heterothallic species showed greater variability.

The scarce isoenzimatic variability, observed within the species of the genus ***Saccobolus***, could reflect a real genetic homogeneity. Other authors wich studied the genus ***Saccobolus***, observed low or null intraspecific variability for other phenotipic characteristics such as morphology and culture, (Mercuri and Ranalli, op. cit.), and growth, (Ramos and Forchiassin, 1998), and for other physiological characteristics tested among them enzymatic productivity, (Ramos and Forchiassin, op. cit.). These finding support the exixtence of genetic homogeneity.

Isozyme analysis is frequently used to solve taxonomic problems, particularly when the morphological characteristics are overlapped or are plastic within the genus or species as happens in ***Saccobolus***. In this genus the species form a continuum, making it often a difficult task, to separate some species with certainty because, many morphological characteristics show hardly any variation between species. Isozyme analysis allows to identify clearly different species of the genus as totally identifiable entities. The ability of these techniques in identifying species rely furthermore, on the degree of genetic variation within the population. In the species studied of the genus

Saccobolus the scarce intraspecific variation (due probably to the type of sexual reproduction) allows to emphasise the interspecific differences and clearly separate the different species. On the other hand, in groups with high genetic variability diagnostic markers are hardly obtained and intraspecific variation may be similar to that observed among species, hindering the clear separation of species within the genus.

As a rule a high degree of association is observed among the ten species of genus ***Saccobolus*** which form one group when the isozyme analysis is taken into account. This agrees with previous morphological and physiological studies, which also show that these species form a continuum difficult to delimit in some cases, due to the high homogeneity in the morphological characters.

Analysis of the isozyme patterns provides an invaluable piece of information about differences and similarities between the species of the genus, indicating that the ten species which were studied constitute independent taxonomic entities, supporting what was already established on the basis of morphology and physiology (Ranalli and Forchiassin, op. cit., Mouso and Ranalli, op. cit., Ranalli and Gonzalez Castelain, op. cit., Ranalli et al., op. cit., Ranalli and Mercuri, op. cit.).

ACKNOWLEDGEMENTS

This work was supported by a grant from the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) and University of Buenos Aires, Argentina.

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MYCOTAXON

Volume LXXIV(2), pp. 463-482 April-June 2000

ARBUSCULAR FUNGI AND MYCORRHIZAE (GLOMALES) OF THE SŁOWIŃSKI NATIONAL PARK, POLAND

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Abstract

The results of 3-year studies of the occurrence of arbuscular fungi (Glomales) and arbuscular mycorrhizae associated with plants colonizing sand dune soils of the Słowiński National Park, Poland are presented and discussed.

Key words: arbuscular mycorrhizal fungi, arbuscular mycorrhizae, Glomales, occurrence, maritime sand dunes

Introduction

Słowiński National Park (SNP; 54°38'-54°46'N, 17°03'-17°33'E) is one of the floristically richest national parks of Poland (Ostrowski and Symonides 1994). It comprises over 830 vascular plant species, among which *ca.* 30% have a narrow distribution range, occurring in single sites or are interesting due to their ecological properties (Piotrowska 1991). However, the uniqueness of SNP mainly results from the presence of active mobile dunes and deflation hollows, which occupy *ca.* 950 ha, i. e., 5.1% of the whole area of the park.

The knowledge of the occurrence of fungi in SNP is exceptionally poor and mainly regards macromycetous fungi (Bujakiewicz 1986; Bujakiewicz and Lisiewska 1983; Hueck 1932; Dominik 1952; Dominik and Pachlewski 1955; Lisiewska 1983). However, preliminary investigations (Błaszkowski 1993a, 1995a) suggested that soils of SNP harbour rich populations of arbuscular mycorrhizal fungi (AMF; Glomales, Zygomycota).

AMF are among the most common soil fungi (Gerdemann 1968) and are associated with *ca.* 80% of plants of the Earth (Gianinazzi and Gianinazzi-Person 1986). Literature data indicate that sand dune soils are especially favourable to AMF (Bergen and Koske 1984; Błaszkowski 1993a; Dalpé 1989; Giovannetti and Nicolson 1983; Koske 1975, 1987, 1988; Koske and Halvorson 1981, 1989; Koske and Tews 1987; Mohankumar *et al.* 1988; Nicolson and Johntson 1979; Puppi and Riess 1987; Rose 1988; Stürmer and Bellei 1994) because of their low nutrient content and organic components (Koske 1975, 1988; Nicolson and Johnston 1979).

However, the abundance of spores and the species diversity of AMF, as well as the incidence of arbuscular mycorrhizae (AM) of dune plants is highly variable, depending on, e. g., the plant species considered (Dalpé 1989; Koske 1988; Koske and Gemma 1996), its developmental stage (Gemma *et al.* 1989), the occurrence of other soil microorganisms (Lee and Koske 1994) and chemical and physical soil properties, such as the mechanical composition (Koske and Halvorson 1981), the contents of organic matter (Koske and Gemma 1997) and mineral components (Rose 1988), pH (Al-Agely and Reeves 1995), moisture (Al-Agely and Reeves 1995; Read 1989) and temperature (Koske 1987). Additionally, the recognition of the occurrence of AMF in a site highly depends on the intensity of its sampling due to the aggregated distribution of spores of these fungi (Bever *et al.* 1996; Friese and Koske 1991; St. John and Koske 1985).

The aim of this paper was to determine the occurrence of AMF and mycorrhizae of plants colonizing different dune sites of SNP.

Materials and methods

The study site was the Słowiński National Park (54°38'-54°46'N, 17°03'-17°33'E). Except for four samples collected in the Bielice Gackie Reserve in south-eastern part of the park, all other soil and root samples were taken from the Łeba Bar (an area of 1-1.5 km wide, 32 km long and rising up to 55 m above sea level, Fig. 1, Table 1).

The areas investigated were mobile dunes, deflation hollows, rampart dunes with white and gray dunes distributed along the shore of the Baltic Sea, and shores of lakes and forest dunes placed between Rąbka and Rowy.

In the mobile dunes, the dominant plant species is *Ammophila arenaria*. Deflation hollows, maritime rampart dunes and shores of lakes are characterized by *Agrostis stolonifera*, *Ammophila arenaria, Carex arenaria* L., *Corynephorus canescens, Festuca rubra* subs. *arenaria, Juncus articulatus, J. balticus*, and *Linaria odora*. The forest dunes are dominated by *Pinus sylvestris* (Ostrowski and Symonides 1994).

Climate. The climate of SNP is highly affected by the immediate neighborhood of the Baltic Sea. Winters and autumns are relatively mild, springs late, and summers short and not very hot. The annual temperature range is the lowest in Poland and the relative humidity is relatively high, usually over 80% (Table 2). The coolest months are January (-0.8°C) and February (-0.5°C), and the hottest are June (16.6°C) and August (16.0°C). The mean number of days with ground frosts is 103 per year. Mean annual precipitation is 640 mm. The growing season ranges from 200-220 days. The most distinctive characteristic of the climate of SNP are strong winds from the south-west, south or north-west.

Collection of samples. Samples of roots and attached soils of randomly selected plants were collected in September 1993 and in July and August 1994-1996. The samples were excavated from a depth of 5-30 cm using a small trowel. About 0.8-2-l soil samples were placed in plastic bags and then stored at 4° C for 2-8 months until processed.

Isolation and identification of AMF. Spores of AMF were isolated from the soils by wet sieving and decanting (Gerdemann and Nicolson 1963). Both intact and crushed spores in polyvinyl/alcohol/glycerin (PVLG) and a mixture of PVLG and Melzer's reagent were investigated at 25-1200x. The fungi were identified according to their original descriptions (Schenck and Pérez 1990), revisions (Morton 1995; Franke and Morton 1994; Stürmer and Morton 1997), information and specimens obtained from Prof. R. E. Koske (Rhode Island University, U.S.A.), Prof. J. M. Morton (West Virginia University, U.S.A.), Prof. J. M. Trappe (Oregon State University, U.S.A.), and Dr. C. Walker (U.K.). Vouchers of all the fungal species recovered are preserved in the authors' collections. Nomenclature of the fungi mentioned in this paper follows Walker and Trappe (1993). Mycorrhizae were determined based on 1-1.5-cm root fragments stained with 0.05% trypan blue (Phillips and Hayman 1970). The percent length of roots with arbuscules, vesicles and hyphae was calculated on the basis of 50 root fragments examined under a light microscope (McGonigle *et al.* 1990).

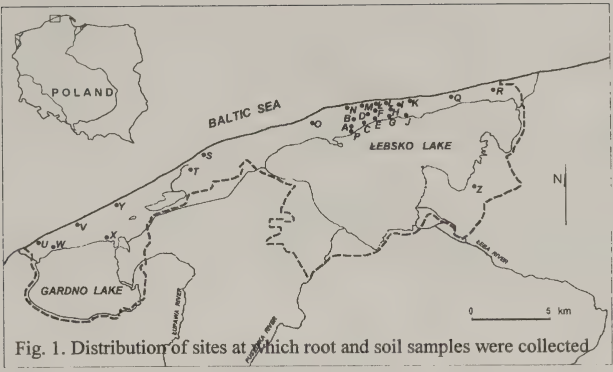


Fig. 1. Distribution of sites at which root and soil samples were collected

Table 1. Sites of sample collection in SNP, their symbols, dates of sampling and numbers of soil and root samples (*vide* Table 3)

Site	Symbol	Data of collection	Number of soil sample
Deflation hollow no. 12	A	23 September 1993	1-13
		29 July 1994	31-54
		30 July 1994	55-66
		31 July 1994	67-72
		1 August 1994	73-78
		27 July 1995	110-127
		28 July 1995	128-145
		29 July 1995	146-157
		1 August 1996	215-220
Deflation hollow no. 11	B	27 July 1994	79-86
		1 August 1996	212-214
Deflation hollow no. 10	C	30 July 1995	158-160
		5 August 1996	248
Deflation hollow no. 9	D	23 September 1993	14-30
		30 July 1995	161-163
		2 August 1996	226, 227
Deflation hollow no. 8	E	30 July 1995	164-166
Deflation hollow no. 7	F	1 August 1995	167-169
		2 August 1996	228-230
Deflation hollow no. 5	G	1 August 1995	170-172
Deflation hollow no. 6	H	2 August 1995	173-175
		2 August 1996	231, 232
		5 August 1996	247
Mobile dunes	I	3 August 1996	233-236
The Łebsko lake bank	J	3 August 1996	237-241
		4 August 1996	242
Rampart dune	K	28 July 1994	105-107
Rampart dune	L	28 July 1994	108, 109
Rampart dune	Ł	28 July 1994	87-99
Rampart dune	M	28 July 1994	103, 104
Rampart dune	N	28 July 1994	100-102
Deflation hollow no. 15	O	2 August 1996	223-225
The Łebsko lake bank	P	2 August 1996	221, 222
Forest dune	Q	4 August 1996	243-246
Forest dune	R	5 August 1996	249, 250
Rampart dune	S	27 July 1996	182-191
Forest dune	T	27 July 1996	176-181
Rampart dune	U	28 July 1996	192-199

Table 1, *continued*

Rampart dune	V	29 July 1996	200-203
The Gardno lake bank	W	29 July 1996	204-206
Forest dune	X	29 July 1996	207
Rampart dune	Y	29 July 1996	208-211
The Bielice Gackie Reservation	Z	7 August 1996	251-254

The nomenclature of plants is after Flora Europea (1964-1980).

Statistical analysis. Differences in the structure of arbuscular fungal communities were investigated by determining the frequency of occurrence of species, spore abundance and species richness.

Results and discussion

General data. During the four years of investigation, the occurrence of AMF and AM in SNP was determined based on 254 soil and root samples. These samples represented 31 plant species in 15 families (Table 3). The plant families most frequently examined were the Poaceae, followed by the Juncaceae and Asteraceae. The plant species most frequently examined were *A. arenaria*, followed by *J. balticus, J. articulatus, C. canescens, A. stolonifera*, *F. rubra* subs. *arenaria* and *H. umbellatum*.

Spores of AMF were found in 174 soil samples, i. e., in 68.50% of all the samples examined. They represented five of the six existing genera of the order Glomales. None of the soil samples examined contained spores of *Sclerocystis* spp. The spore populations recovered comprised 30 species, including 2 undescribed *Glomus* spp. (Table 4).

Lower frequency of occurrence of AMF in dune soils has only been found in Canada (52.20%; Dalpé 1989). The level of occurrence of these fungi in other dunes ranged from 74.16% to 100.00% (Błaszkowski 1993a, 1994c; Koske 1975; Koske and Gemma 1990, 1996; Koske *et al.* 1992; Logan *et al.* 1989; Mohankumar *et al.* 1988; Puppi and Riess 1987).

The AMF most frequently occurring in SNP were members of the genus *Glomus*. Fungi of this genus were present in 48.82% of the soil samples investigated and constituted 53.73% of all the spores of AMF isolated. Fungi most numerously encountered in SNP by Błaszkowski (1993a) were *Acaulospora* spp. However, results of this study were based on only 33 soils sampled from a relatively small area.
Intensity of sampling highly influences the extent of elucidation of structure of AMF community of a site (Bever *et al.* 1996; St. John and Koske 1988).

Frequency of occurrence. The fungus most frequently encountered in soils of SNP was *S. dipurpurescens* (Table 4). Other frequently found species were *A. koskei*, *G. aggregatum*, *Glomus* 107, *A. rugosa* and *A. lacunosa*.

Spore abundance. The overall average abundance of spores of AMF in SNP was 75.94 and ranged from 0 to 1523 spores in 100 g dry soil. The highest abundance of spores was in soils collected under the Rosaceae and Poaceae (Table 5).

Of the plant species sampled at least three times (Table 6), the most abundant spore populations were found in the root zones of *C. canescens* and *A. stolonifera*, and fewest spores were recovered from under *J. balticus* (49.49). The range of spore abundance of AMF in soils of SNP is similar to the ranges recorded in maritime dunes of the Baltic Sea (0-1006; Błaszkowski 1993a), the Hel Peninsula (1-547; Błaszkowski 1994c), Florida (0-677; Sylvia 1986; Sylvia and Will 1988)

Table 2. Air temperatures and rainfalls in the years 1993-1996 compared with averages of these parameters of the years 1966-1995 (based on measurements of the Łeba Meteorological Station)

Month	Temperature (°C)					Rainfalls (mm)				
	Monthly average of the years 1966-1995	Deviation from the average of the years 1966-1995				Monthly average of the sum of the years 1966-1995	Deviation from the average sum of the years 1966-1995			
		1993	1994	1995	1996		1993	1994	1995	1996
I	–0.8	+2.3	+2.9	+0.4	–2.0	42	+5	+46	+21	–34
II	–0.5	+1.6	–2.1	+3.9	–3.4	29	+10	–1	–3	+3
III	2.3	–0.1	+0.4	+0.6	–2.7	37	–1	+32	–10	–31
IV	5.4	+1.4	+1.7	+0.5	+1.3	34	–22	–22	+7	–16
V	10.5	+3.6	–1.2	–0.2	–1.5	44	–36	–6	+18	+65
VI	14.0	–0.4	–0.2	+0.4	–0.2	49	–1	–13	+3	–22
VII	16.6	–0.9	+2.4	+1.1	–1.8	69	+17	–66	–41	+16
VIII	16.0	–0.4	+1.0	+1.3	+1.0	69	+46	+13	–20	–1
IX	13.2	–1.9	+0.5	+0.1	–2.4	78	+3	0	+37	+13
X	8.7	–0.5	–1.4	+2.3	+0.5	70	–52	+41	–42	–12
XI	4.3	–4.1	+1.0	–1.7	+0.6	66	–47	–12	–34	–13
XII	0.9	+1.1	+1.8	–1.9	–1.5	53	+16	+9	–15	–34

Table 3. Plants examined and soil samples in which the occurrence of mycorrhizal arbuscular fungi were investigated

Plant	Number of soil sample
Asteraceae	
Helichrysum arenarium (L.) Moench	194, 202
Hieracium pilosella L.	220
Hieracium umbellatum L.	183, 186, 193, 197, 211, 213, 221, 242, 252
Petasites spurius (Retz.) Reichenb.	195, 200
Boraginaceae	
Echium vulgare L.	176
Convolvulaceae	
Convolvulus arvensis L.	178
Cupressaceae	
Juniperus communis L.	205
Guttiferae	
Hypericum perforatum L.	179
Juncaceae	
Juncus articulatus L.	6-8, 16, 19, 22, 31-34, 39-41, 47, 53, 79, 83, 112, 113, 115, 120, 122, 124, 127, 131, 132, 154, 155, 157, 160, 163, 166, 173, 175, 215, 230, 233
Juncus balticus Willd.	10-13, 25-30, 38, 44, 51, 52, 54, 55, 58, 61-66, 70, 72-78, 84, 86, 116, 119, 125, 128, 137, 141, 142, 145-148, 150, 153, 156, 214, 228, 236, 239
Juncus conglomeratus L.	204
Leguminosae	
Lathyrus japonicus subsp. *maritimus* (L.) P. W. Ball	203
Vicia cracca L.	177
Onagraceae	
Epilobium angustifolium L.	180
Pinaceae	
Pinus sylvestris L.	1, 14
Plantaginaceae	
Plantago lanceolata L.	181
Poaceae	
Agrostis stolonifera L.	5, 9, 17, 21, 35, 37, 46, 80, 111, 117, 121, 126, 158, 162, 164, 168, 170, 216, 232
Ammophila arenaria (L.) Link.	3, 4, 15, 23, 24, 36, 42, 45, 50, 56, 60, 69, 81, 87, 88, 91-98, 100-102, 105-110, 114, 118, 123, 129, 133, 136, 139, 144, 151, 161, 165, 167, 171, 174, 182, 188, 198, 208, 212, 217, 219, 222, 223, 225, 227, 229, 231, 234, 235, 237, 240, 241, 244-247, 250
Corynephorus canescens (L.) Beauv.	20, 43, 48, 49, 67, 68, 82, 85, 89, 90, 99, 104, 130, 134, 138, 159, 169, 172, 185, 218, 226, 238, 243, 249
Festuca rubra subsp. *arenaria* (Osbeck) Syme	2, 18, 57, 59, 71, 103, 135, 140, 143, 149, 152, 184, 192, 207, 253
Koeleria glauca (Schrader) DC.	251
Leymus arenarius (L.) Hochst	209, 210
Molinia caerulea subsp. *arundinacea* (Schrank) H. Paul	191
Phalaris arundinacea L.	189
Linaria odora (Bieb.) Fischer	224
Melampyrum pratense L.	190, 254
Violaceae	
Viola tricolor L.	187

Table 4. Arbuscular mycorrhizal fungi isolated from among the roots of plants of the Słowiński National Park

Fungal species	Frequency of occurrence (%)
Acaulospora dilatata	0.79
Acaulospora koskei	25.98
Acaulospora lacunosa	11.02
Acaulospora paulineae	3.54
Acaulospora polonica	1.18
Acaulospora rugosa	13.78
Acaulospora trappei	1.97
Acaulospora sp.	1.97
Entrophospora baltica	2.36
Gigaspora gigantea	1.18
Gigaspora sp.	0.39
Glomus aggregatum	18.50
Glomus constrictum	7.48
Glomus corymbiforme	2.36
Glomus deserticola	3.94
Glomus dominikii	1.18
Glomus etunicatum	3.94
Glomus fasciculatum	1.58
Glomus fuegianum	0.39
Glomus intraradices	1.97
Glomus laccatum	0.79
Glomus macrocarpum	1.97
Glomus microcarpum	3.54
Glomus pansihalos	0.39
Glomus pustulatum	5.91
Glomus rubiforme	0.39
Glomus 107	15.75
Glomus 111	3.54
Glomus sp.	3.94
Scutellospora armeniaca	8.27
Scutellospora dipurpurescens	35.04
Scutellospora pellucida	2.76
Scutellospora persica	1.97
Glomales spores of an unrecognized generic affiliation	0.39

and Lake Huron (0-632; Koske *et al.* 1975). Lower spore abundances of these fungi were found in maritime sands of Pakistan (1-29; Khan 1974), Italy (0-250; Puppi and Riess 1987), New South Wales (0-110; Koske 1975), Massachusetts (0.2-16.2; Bergen and Koske 1984), Rhode Island (101-336; Koske and Halvorson 1981) and Santa Catarina (0-69; Stürmer and Bellei 1994).

Species richness. The average species richness of AMF at SNP was 1.90 and ranged from 0.00 to 7.00 in 100 g dry soil. Of the five plant families examined more than two times (Table 5), most species contained samples representing the Poaceae, Asteraceae and Salicaceae.

Of the seven plant species sampled more than twice (Table 6), the species richness was highest among roots of *A. arenaria* and lowest in the root zone of *J. balticus*.
Similar overall average species richness data were recorded from dunes of the Cape Cod, Massachusetts, (av. 1.7; Bergen and Koske 1984), SNP (av. 2.4) and the Szczecin coast (av. 2.2) examined by Błaszkowski (1993a), New South Wales (av. 1.5-2.4; Koske 1975) and Hawaii (av. 2.0 and 2.4; Koske 1988, Koske and Gemma 1996, respectively). Higher richness values were noted in dunes of the Gdańsk coast (av. 3.6; Błaszkowski 1993a), the Hel Peninsula (av. 3.9; Błaszkowski 1994c), Rhode Island (av. 3.1; Koske

and Halvorson 1981), New Jersey to Virginia (av. 4.9; Koske 1987) and Santa Catarina, Brazil (av. 5.9; Stürmer and Bellei 1994).

Table 5. Spore abundance* and species richness* of arbuscular mycorrhizal fungi among roots of 15 plant families

Family	n	Spore abundance	Species richness
Asteraceae	14	28.14	2.14
Boraginaceae	1	36.00	5.00
Convolvulaceae	1	15.00	2.00
Cupressaceae	1	0.00	0.00
Guttiferae	1	4.00	2.00
Juncaceae	89	54.83	1.30
Leguminosae	2	43.00	2.50
Onagraceae	1	0.00	0.00
Pinaceae	2	27.00	2.00
Plantaginaceae	1	60.00	4.00
Poaceae	132	102.05	2.28
Rosaceae	2	106.00	4.00
Salicaceae	3	23.00	2.00
Scrophulariaceae	3	2.33	0.67
Violaceae	1	0.00	0.00

* in 100 g dry soil
n - number of soil samples examined

Table 6. Spore abundance* and species richness* of arbuscular mycorrhizal fungi among roots of 31 plant species

Family	n	Spore abundance	Species richness
Agrostis stolonifera	19	149.26	2.05
Ammophila arenaria	69	79.51	2.52
Convolvulus arvensis	1	15.00	2.00
Corynephorus canescens	24	160.17	2.13
Echium vulgare	1	36.00	5.00
Epilobium angustifolium	1	0.00	0.00
Festuca rubra subsp. *arenaria*	15	79.73	1.80
Helichrysum arenarium	2	14.50	2.00
Hieracium pilosella	1	2.00	1.00
Hieracium umbellatum	9	25.78	2.22
Hypericum perforatum	1	4.00	2.00
Juncus articulatus	37	63.68	1.41
Juncus balticus	51	49.49	1.26
Juncus conglomeratus	1	0.00	0.00
Juniperus communis	1	0.00	0.00
Koeleria glauca	1	32.00	1.00
Lathyrus japonicus subsp. *maritimus*	1	84.00	4.00
Leymus arenarius	2	37.50	4.00
Linaria odora	1	7.00	2.00
Melampyrum pratense	2	0.00	0.00
Molinia caerulea subsp. *arundinacea*	1	0.00	0.00
Petasites spurius	2	65.50	2.50
Phalaris arundinacea	1	2.00	1.00
Pinus sylvestris	2	27.00	2.00
Plantago lanceolata	1	60.00	2.00
Potentilla erecta	1	8.00	3.00
Rosa rugosa	1	204.00	5.00
Salix acutifolia	2	3.00	2.00

Table 6, *continued*

Salix arenaria	1	63.00	2.00
Vicia cracca	1	2.00	1.00
Viola tricolor	1	0.00	0.00

* in 100 g dry soil
n - number of soil samples examined

The distribution of arbuscular mycorrhizal fungi in the Słowiński National Park and notes on their general occurrence

Abbreviations:
Distr. - distribution
n - the number of soil samples in which a particular fungal species was found. The numbers following are those of soil samples given in Table 1 and Fig. 1.

1. *Acaulospora dilatata* Morton
n=2: 93, 105.

Błaszkowski (1994a) also found *A. dilatata* associated with *A.* arenaria growing in dunes of SNP. Dalpé (1989) recovered this fungus from dunes of Quebec. *Acaulospora dilatata* was originally isolated from two sites of West Virginia with high aluminium and low pH soils (Morton 1986).

2. *Acaulospora koskei* Błaszk.
n=66: 4, 5, 7, 9, 10, 12, 14, 26, 37, 38, 40-42, 44-46, 48-54, 56-59, 62, 64-66, 80-84, 117, 118, 120, 121, 123-127, 129, 130, 132-137, 139, 140, 142-144, 151, 160, 161, 208, 216, 240, 246, 248.

Acaulospora koskei ranked second in respect of both the frequency of occurrence and abundance of AMF of SNP. The original description of *A. koskei* has been prepared based on spores encountered in dunes of SNP (Błaszkowski 1995a). This fungus has also been recorded in dune soils of the United Kingdom and cultivated soils of the U.S.A. (Walker, Morton pers. comm.).

3. *Acaulospora lacunosa* Morton
n=28: 10, 43, 51, 60, 69, 87-91, 94, 129, 136, 143, 148, 182, 184, 186, 188, 193, 206, 208, 213, 217, 222, 243-245.

This fungus commonly occurs in dune soils of the Baltic Sea coast (Błaszkowski 1993a, 1994c) and has frequently been found in many uncultivated and cultivated sites of Poland (Błaszkowski 1991a; Błaszkowski and Tadych, pers. observ.). This species is relatively common in dunes of the U.S. Atlantic coast from Massachusetts to Virginia (Koske and Gemma 1997). *Acaulospora lacunosa* has originally been encountered under *Andropogon virginicus* L. growing in West Virginia (Morton 1986).

4. *Acaulospora paulineae* Błaszk.
n=9: 30, 47, 50, 57, 104, 106, 139, 176, 178.

Despite the infrequent records of this species in the investigations discussed here, it has earlier frequently been found in dunes of SNP, the Gdańsk coast and the Hel Peninsula (Błaszkowski 1993a, 1994c). Koske *et al.* (1997) found *A. paulineae* to occur under *Agrostis canina* Huds., *A. palustris* L. and *Poa annua* L., perennial turf species of golf greens of Rhode Island, U.S.A.

5. *Acaulospora polonica* Błaszk.
n=3: 49, 50, 229.

Acaulospora polonica was recorded earlier from SNP and the Hel Peninsula (Błaszkowski 1991a, 1994c). This fungus has also been associated with roots of *J.*

communis growing in inland dunes of the Błędowska Desert in southern Poland (Błaszkowski, Tadych pers. observ.).

6. *Acaulospora rugosa* Morton

n=35: 4, 8, 37, 43, 44, 50-52, 54, 82, 104, 125, 126, 129, 130, 132, 133, 135, 136, 138, 139, 153, 189, 209, 210, 216, 219, 221, 223, 224, 227, 229, 232, 242, 246.

Acaulospora rugosa was fifth among the most frequently recovered species and sixth in the group of dominants of AMF found in this study. This is the first report of the occurrence of this species in maritime dunes of both Poland and the world. Błaszkowski (1990a) found *A. rugosa* associated with *Calamagrostis aruniacea* (L.) Roth growing in a forest. This fungus has also been found associated with roots of plants colonizing inland dunes of the Błędowska Desert situated in southern Poland (Błaszkowski, Tadych pers. observ.). *Acaulospora rugosa* was described based on spores recovered from the root zone of *A. virginicus* growing in West Virginia (Morton 1986).

7. *Acaulospora trappei* Ames & Linderman

n=5: 23, 41, 123, 127, 239.

This is the first record of the occurrence of *A. trappei* in maritime dune soils. In Poland, this fungus has also been associated with roots of *Festuca rubra* L. colonizing dunes of the Błędowska Desert (Błaszkowski, Tadych pers. observ.). However, examination of trap pot cultures established based on soils of many other dune sites of Poland indicate that this fungus is a very frequent inhabitant. *Acaulospora trappei* forms small, hyaline spores with a wall composed of thin and delicate layers. Hence, the lack of records of this fungus in other dune sites of the world, mainly investigated based on field-collected soils, may result from either the omission of its spores or their absence at the period of soil sampling due to decomposition. This species has originally been known from *Lilium longiflorum* Thunb. fields along southern Oregon and northern California coastal areas (Ames and Linderman 1976).

8. *Entrophospora baltica* Błaszk., Madej & Tadych

n=6: 194, 197, 201, 203, 209, 210.

Entrophospora baltica has originally been recovered from among roots of *A. arenaria* and *P. spurius* colonizing dunes adjacent to Świnoujście in north-western Poland (Błaszkowski *et al.* 1998).

9. *Gigaspora gigantea* (Nicol. & Gerd.) Gerd. & Trappe

n=3: 87-89.

In Poland, *Gi. gigantea* has earlier been recorded under different plants of dune sites of the Baltic Sea coast (Błaszkowski 1990b, 1991a, 1994c). This species commonly occurs in *A. breviligulata* Fern.-dominated dunes of the Atlantic coast of North America from Quebec to Virginia (Bergen and Koske 1984; Dalpé 1989; Gemma and Koske 1988; Gemma *et al.* 1989; Koske 1987; Koske and Halvorson 1981). Rose (1980) and Sylvia and Will (1988) found this fungus in dunes of Florida. *Gigaspora gigantea* also inhabited dunes of Wisconsin (Koske and Tews 1987) and New South Wales (Koske 1975).

10. *Glomus aggregatum* Schenck & Smith emend. Koske

n=47: 6, 9, 18, 19, 24, 25, 43-45, 49-54, 56-58, 60, 81, 84, 87-89, 134-139, 144, 148, 149, 158, 160, 162, 175, 196, 197, 200, 216, 218-220, 227, 229, 238.

Glomus aggregatum was third in frequency of occurrence and first in the group of dominants of AMF of SNP. This fungus has earlier been found associated with different plants of many sand dunes of the Baltic Sea shore (Błaszkowski 1991b), the Hel Peninsula (Błaszkowski (1994) and sands of the bank of the Odra river (Błaszkowski 1991b). This species regularly occurred in dunes of the eastern coast of North America

(Dalpé 1989; Friese and Koske 1991; Gemma and Koske 1989; Koske 1987; Sylvia 1986; Sylvia and Will 1988), Wisconsin (Koske and Tews 1987), Florida (Sylvia 1986; Sylvia and Will 1988), San Miguel Island (Halvorson and Koske 1987; Koske and Halvorson 1989) and Hawaii (Koske 1988).

Glomus aggregatum probably plays an important role in stabilization of dunes and sandy river banks due to the formation of extensive extramatrical hyphae binding sand grains into aggregates (Błaszkowski 1991b; Koske 1985).

11. *Glomus constrictum* Trappe

n=19: 8, 22, 44, 87, 88, 91, 96, 99, 130, 176, 179, 181, 184, 188, 192, 193, 196, 197, 201.

Glomus constrictum has been a frequent inhabitant of other dunes of the Baltic Sea shore (Błaszkowski 1993a, 1994c). This species has been recorded from dunes of Quebec, New Brunswick and New Scotia, Canada (Dalpé 1989) and dunes distributed from New Jersey to Virginia (Koske 1987). It has also been recovered from dunes of Hawaii (Koske 1988) and Santa Catarina, Brazil (Stürmer and Bellei 1994).

12. *Glomus corymbiforme* Błaszk.

n=6: 58, 106, 108, 197, 200, 219.

This fungus has been described based on spores found under *A. arenaria, H. umbellatum* and *P. spurius* growing in dunes adjacent to Świnoujście in north-western Poland (Błaszkowski 1995b). There are no other records of the occurrence of *G. corymbiforme* in other dune sites of the world.

13. *Glomus deserticola* Trappe, Bloss & Menge

n=10: 1, 17, 70, 91, 95, 96, 99, 117, 188, 203.

Glomus deserticola is rare in dunes of SNP, but common among roots of plants growing in other dunes along the Baltic Sea shore (Błaszkowski 1993a, 1994c). This fungus has been present in dunes of Florida (Sylvia 1986; Sylvia and Will 1988; Will and Sylvia 1990).

14. *Glomus dominikii* Błaszk.

n=3: 105, 176, 179.

The only earlier record of *G. dominikii* from dunes is that from the Hel Peninsula (Błaszkowski 1994c).

15. *Glomus etunicatum* Becker & Gerd.

n=10: 9, 22, 53, 70, 92, 94, 95, 186, 210, 221.

This species occurred in dunes of the Baltic Sea coast (Błaszkowski 1991a, 1993a, 1994c), Rhode Island (Koske and Halvorson 1981), Wisconsin (Koske and Tews 1987), San Miguel Island (Koske and Halvorson 1989) and Santa Catarina, Brazil (Stürmer and Bellei 1994).

16. *Glomus fasciculatum* (Thaxter) Gerd. & Trappe emend. Walker & Koske

n= n=4: 22, 136, 184, 203.

Glomus fasciculatum has been present in dunes of the Baltic Sea coast and the Hel Peninsula (Błaszkowski 1991a, 1993a, 1994c) and the eastern and western shores of North America (Dalpé 1989; Bergen and Koske 1984; Gemma and Koske 1989; Koske and Halvorson 1981; Rose 1988).

17. *Glomus fuegianum* (Spegazzini) Trappe & Gerd.

n=1: 106.

There is no literature data on the existence of *G. fuegianum* in maritime dunes. However, Błaszkowski (1991a) and Błaszkowski *et al.* (1998) found this species in inland dunes of the Kampinos National Park situated in central Poland.

18. *Glomus intraradices* Schenck & Smith n=5: 231, 232, 237, 241, 247.

This fungus has been recorded from dunes of north-western Poland (Błaszkowski 1995b), Madras, India (Mohankumar *et al.* 1988), Canada (Dalpé 1989), San Miguel Island (Halvorson and Koske 1987; Koske and Halvorson 1989) and Hawaii (Koske 1988; Koske and Gemma 1996).

19. *Glomus laccatum* Błaszk.

n=2: 4, 129.

Other dune sites of *G. laccatum* mentioned in the literature are only those of the Gdańsk coast, Poland (Błaszkowski 1988b; Błaszkowski 1994c).

20. *Glomus macrocarpum* Tul. & Tul.

n=5: 13, 88, 104, 151, 217.

This fungus has been present in other dunes of the Baltic Sea coast (Błaszkowski 1991a, 1993b, 1994c), Italy (Puppi and Riess 1987), Canada (Dalpé 1989) and Wisconsin (Koske and Tews 1987).

21. *Glomus microcarpum* Tul. & Tul.

n=9: 87, 104, 181, 182, 193, 196, 200, 208, 210.

This species has earlier been recorded to occur in dunes of the Baltic Sea coast (Błaszkowski 1993a, b, 1994c), Madras, India (Mohankumar *et al.* 1988) and Italy (Puppi and Riess 1987).

22. *Glomus pansihalos* Berch & Koske

n=1: 22.

In Poland, this fungus has been encountered in other dune areas of the Baltic Sea coast (Błaszkowski 1990e, 1991a, 1994c). Berch and Koske (1986) found *G. pansihalos* spores in dunes of California and Michigan. Koske (1987) isolated this fungus from dunes extending from New Jersey to Virginia. Halvorson and Koske (1987) and Koske and Halvorson (1989) recorded it in dunes of San Miguel Island.

23. *Glomus pustulatum* Koske, Friese, Walker & Dalpé

n=15: 4, 6-9, 13, 16, 21-24, 26, 39,49,60.

In Poland, this fungus has earlier been found in dunes of SNP (Błaszkowski 1994b) and those adjacent to Świnoujście (Błaszkowski 1995b). It also occurred in dunes of Canada (Dalpé 1989) and the eastern U.S. coast (Koske *et al.* 1986). Mohankumar *et al.* (1988) listed *G. pustulatum* among AMF of the Madras coast, India.

24. *Glomus rubiforme* (Gerd. & Trappe) Almeida & Schenck

n=1: 108.

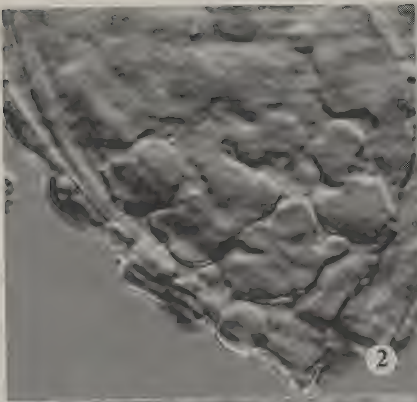
Błaszkowski (1991a) recorded this fungus from sands of the Gdańsk coast. Other maritime dune sites containing *G. rubiforme* spores were those of Canada (Dalpé 1989) and Rhode Island (Friese and Koske 1991).

25. *Glomus* 107

n=40: 5, 10, 12, 14, 18, 20, 37, 38, 40-42, 44, 45, 50, 59, 79-82, 84, 116-118, 120, 121, 123, 125, 127, 131, 132, 143, 160, 171, 172, 212, 216, 217, 237, 239, 240.

Glomus 107 was the only eudominant and the forth species regarding the frequency of occurrence of AMF in soils of SNP.

Spores occurring singly in the soil; orange to golden yellow; globose to subglobose; (90-)111(-130)μm; sometimes ovoid; 70-110x105-190 μm; with a single subtending hypha. *Spore wall structure* composed of four layers (layers 1-4; Figs. 2-5). The outermost layer 1 rigid, orange to golden yellow, 1.5-1.7 μm thick in the basal part, 2.7-4.9 μm thick in the thickenings making the spore surface pustulate (Figs. 2-3). Layer 2 laminated, pale yellow, 4.7-6.6 μm thick. Layers 3 and 4 flexible, hyaline, *ca.* 0.5 μm thick. Layers 1-4 not reacting in Melzer's reagent. *Subtending hypha* (Fig. 5) orange to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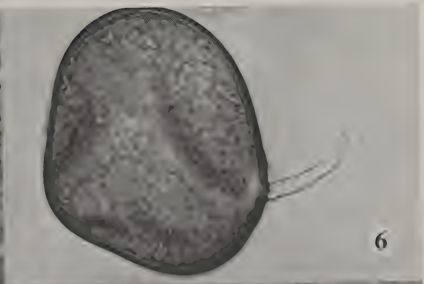
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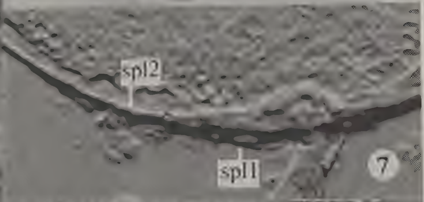

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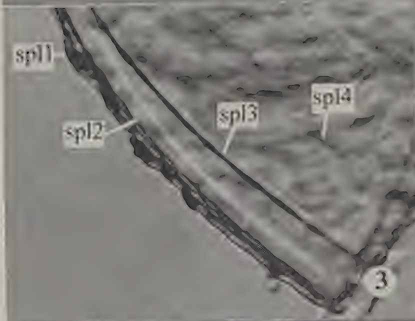
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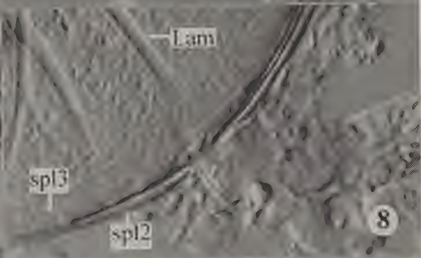
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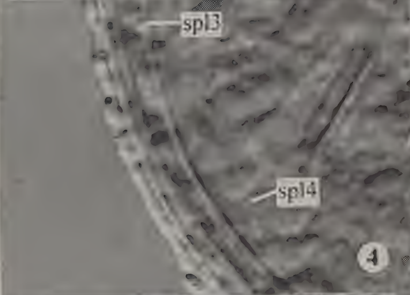

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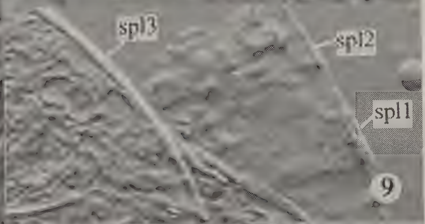
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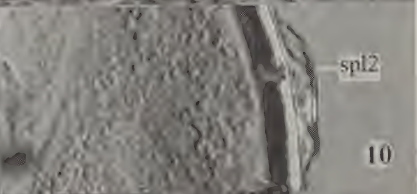

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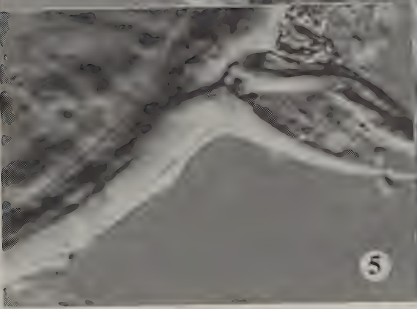
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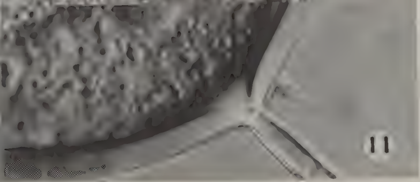
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golden yellow; straight or recurved, funnel-shaped, 6.4-7.5 μm wide at the spore base. *Pore* occluded by a septum continuous with the innermost lamina of layer 2.

Spores of *Glomus* 107 closely resemble those of *G. pustulatum* Koske *et al.* (Koske *et al.* 1986) due to the similarity in spore colour and the formation of thickenings by the outermost spore wall layer 1. The main property distinguishing the two fungi is the presence of two hyaline flexible layers in *Glomus* 107 compared with a single layer of *G. pustulatum*.

26. *Glomus* 111

n=9: 58, 174, 188, 194, 197, 200, 201, 209, 222.

This fungus has also been found in dunes adjacent to Świnoujście (Błaszkowski and Tadych pers. observ.).

Spores occurring singly in the soil or sometimes in roots; orange to raw umber; globose to subglobose; (55-)97(-120) μm diam; sometimes ovoid; 65-105x95-140 μm; usually with a single subtending hypha (Fig. 6), sometimes with two subtending hyphae. Spores with one wall consisting of three layers (layers 1-3; Figs. 7-9). The outermost layer 1 hyaline, (0.5-)0.9(-1.5) μm thick before decomposition, tightly adherent to layer 2, absent in mature spores. Layer 2 hyaline, smooth, (0.7-)1.1(-1.5) μm thick, sloughing with age; rarely present in mature spores. Layer 3 laminated, smooth, orange to raw umber, (2.0-)6.1(-8.8) μm thick. Layers 1-3 not reacting in Melzer's reagent. *Subtending hypha* (Figs 6, 11) hyaline to yellowish white, straight or recurved, cylindric to funnel-shaped, rarely constricted; (3.7-)4.9(-8.1) μm wide at the spore base. *Pore* occluded by a septum, 2.3-4.7 μm wide, continuous with the innermost lamina of layer 3 (Fig. 11).

Glomus 111 most resemble *G. etunicatum* in color, size and shape of spores. However, the spore wall of *G. etunicatum* consists of a mucilaginous outer layer tightly adherent to a laminate inner layer (Stürmer and Morton, 1997). In contrast, the wall of *Glomus* 111 spores is composed of a sloughing outermost layer closely associated with a semiflexible middle layer that easily separates from a laminate innermost layer. Although the outermost layers of the two fungi are similar in appearance and quickly slough, the mucilaginous layer of *G. etunicatum* spores stains dark pinkish to reddish purple and that of spores of *Glomus* 111 does not react in this reagent. Additionally, the subtending hypha of *Glomus* 111 spores is persistent and usually present in mature spores, whereas that of spores of *G. etunicatum* frequently breaks at the spore base.

27. *Scutellospora armeniaca* Błaszk.

n=21: 49, 69, 82, 87, 91, 93, 95, 104, 105, 176, 178, 188, 202, 203, 206, 209, 221, 222, 241, 244, 251.

This fungus is a common inhabitant of both maritime and inland dunes of Poland (Błaszkowski 1992, 1995b), but was not recorded from other dune sites of the world.

28. *Scutellospora dipurpurescens* Morton & Koske

n=89: 1, 4, 8, 9, 18, 20, 23, 24, 37, 38, 43-47, 49-54, 56-60, 69, 79, 82, 87-89, 91-94, 96, 99, 100, 103-105, 117, 126, 129-131, 133, 134, 136-139, 143, 144, 150, 151, 158,

Figs. 2-5. *Glomus* 107. 2. Spore surface with outgrowths in a plan view. 3-4. Four spore wall layers (spl 1-4). 5. Subtending hypha. **Figs. 6-11.** *Glomus* 111. 6. Spore with narrow, hyaline subtending hypha. 7. Most juvenile spore with spore wall layers (spl) 1 and 2. 8. Juvenile spore with spore wall layers (spl) 2 and 3 and wrinkled lamina (lam). 9. Spore wall layers (spl) 1-3 of a young spore. 10. Swollen layer 2 of a mature spore; layer 1 is completely sloughed. 11. Narrow subtending hypha occluded by a septum of a mature spore with layers 1 and 2 sloughed and the laminate layer 3 remaining. Fig. 6, bright field microscopy, x 515. Figs. 2-5, 7-11, differential interference contrast, x 1428.

171, 172, 174, 175, 186, 188, 196, 197, 212, 213, 218, 219, 221, 223, 224, 226, 227, 229-234, 237-240, 245-248.

Scutellospora dipurpurescens was the most frequently encountered species and ranked third among the eudominants of AMF in this study. This fungus also dominated in soils of the Hel Peninsula (Błaszkowski 1994c) and frequently occurred among roots of plants of inland dunes of the Błędowska Desert (Błaszkowski, Tadych pers. observ.). *Scutellospora dipurpurescens* is closely related with *S. calospora* (Nicol. & Gerd.) Walker & Sanders, a fungus reported from many dune sites of the world (Dalpé 1989; Giovannetti and Nicolson 1983; Koske and Gemma 1997; Koske and Halvorson 1981, 1989).

29. ***Scutellospora pellucida*** (Nicol. & Schenck) Walker & Sanders
n=7: 91, 95, 96, 176, 192, 197, 241.

In Poland, *S. pellucida* has additionally been found in maritime dunes of the Hel Peninsula, the Gdańsk and Szczecin coasts (Błaszkowski 1993a). This fungus is common in dunes of the eastern coast of North America from Quebec to Virginia (Bergen and Koske 1984; Dalpé 1989; Friese and Koske 1991; Gemma and Koske 1989; Gemma *et al.* 1989; Koske 1987). Rose (1988) found it in dunes of the California coast.

30. ***Scutellospora persica*** (Koske & Walker) Walker & Sanders
n=5: 192, 194, 200, 201, 234.

This fungus also occurred in dunes of Świnoujście, Poland (Błaszkowski and Tadych 1997), Italy (Puppi and Riess 1987), Greece (Błaszkowski and Tadych 1997) and the eastern coast of the U.S. (Bergen and Koske 1984; Friese and Koske 1991; Gemma and Koske 1989; Gemma *et al.* 1989; Koske 1987; Koske and Gemma 1997; Koske and Walker 1985).

The occurrence of arbuscular mycorrhizae

Of the 31 examined plant species of SNP, 27 (87.10%) were associated with AMF (Table 7). However, arbuscules were found in roots of only 20 plant species (64.50%). Presence of arbuscules evidences a functional symbiosis (Harley and Smith 1983).

Arbuscules. The highest percent of root length with arbuscules (Table 7) was found in *P. lanceolata*, followed by *P. spurius* and *H. arenarium*. However, all the plant species were sampled only once. No arbuscules were found in 11 plant species represented by 1 or 2 root samples.

Vesicles. Of the plant species examined at least three times (Table 7), the highest percent of root length with vesicles was found in *C. canescens*, and lowest in *J. balticus*.

Hyphae. Considering plant species investigated at least three times (Table 7), the highest percent of root length with AMF hyphae was found in *H. umbellatum*, followed by *A. stolonifera, J. articulatus* and *A. arenaria*. Roots of *J. conglomeratus, J. communis*, *P. sylvestris* and *P. erecta* lacked hyphae of AMF.

The presence of AM in 87.10% of the plants investigated in this study supports Gerdemann's (1968) suggestion that about 80% of plants of the Earth are associated with AMF.

The plants of SNP investigated at least twice in this study and found to consistently form AM were *H. arenarium, H. umbellatum*, *L. arenarius, P. spurius* and *S. acutifolia*. The authors of this paper found no report of the mycorrhizal status of *H. arenarium* and *S. acutifolia*, members of the families Asteraceae and Salicaceae, respectively.

Table 7. The percent of root length with arbuscules, vesicles and hyphae of arbuscular mycorrhizal fungi in 31 plant species

Plant species		Arbuscules		Vesicles		Hyphae	
	n	Average	Range	Average	Range	Average	Range
Agrostis stolonifera	19	0.40	0.00-2.00	2.50	0.00-18.00	8.40	0.00-44.00
Ammophila arenaria	69	1.50	0.00-24.00	2.40	0.00-21.00	7.10	0.00-36.00
Convolvulus arvensis	1	0.00	-	1.00	-	5.00	-
Corynephorus canescens	24	0.50	0.00-5.00	3.10	0.00-30.00	4.10	0.00-20.00
Echium vulgare	1	2.00	-	4.00	-	6.00	-
Epilobium angustifolium	1	4.00	-	1.00	-	9.00	-
Festuca rubra subsp. *arenaria*	15	0.10	0.00-1.00	2.10	0.00-14.00	4.50	0.00-16.00
Helichrysum arenarium	2	11.00	0.00-22.00	4.50	0.00-9.00	10.00	2.00-18.00
Hieracium pilosella	1	0.00	-	0.00	-	4.00	-
Hieracium umbellatum	9	4.70	0.00-16.00	1.70	0.00-7.00	8.90	4.00-27.00
Hypericum perforatum	1	0.00	-	2.00	-	4.00	-
Juncus articulatus	37	0.70	0.00-8.00	1.70	0.00-10.00	8.20	0.00-59.00
Juncus balticus	51	0.20	0.00-5.00	1.40	0.00-30.00	2.60	0.00-44.00
Juncus conglomeratus	1	0.00	-	0.00	-	0.00	-
Juniperus communis	1	0.00	-	0.00	-	0.00	-
Koeleria glauca	1	1.00	-	1.00	-	3.00	-
Lathyrus japonicus subsp. *maritimus*	1	3.00	-	0.00	-	11.00	-
Leymus arenarius	2	4.50	2.00-7.00	1.50	1.00-2.00	10.50	7.00-14.00
Linaria odora	1	2.00	-	0.00	-	3.00	-
Melampyrum pratense	2	0.00	-	0.00	-	5.50	0.00-11.00
Molinia caerulea subsp. *arundinacea*	1	2.00	-	0.00	-	3.00	-
Petasites spurius	2	13.50	4.00-23.00	5.00	0.00-10.00	14.00	5.00-23.00
Phalaris arundinacea	1	0.00	-	1.00	-	4.00	-
*Pinus sylvestris**	2	0.00	-	0.00	-	0.00	-
Plantago lanceolata	1	17.00	-	4.00	-	40.00	-
Potentilla erecta	1	0.00	-	0.00	-	0.00	-
Rosa rugosa	1	1.00	-	0.00	-	4.00	-
Salix acutifolia	2	0.00	-	0.50	0.00-1.00	2.50	2.00-3.00
Salix arenaria	1	0.00	-	1.00	-	1.00	-
Vicia cracca	1	3.00	-	0.00	-	5.00	-
Viola tricolor	1	4.00	-	7.00	-	17.00	-

* *Pinus sylvestris* harboured ecto-, ectendomycorrhizae and numerous chlamydospores of *Complexipes moniliformis* Walker emend. Yang et Korf and zygospores of *Endogone* spp. n - number of soil samples examined

According to Harley and Harley (1987a), over 90% of *ca.* 150 plant species of the Asteraceae of the British flora harboured AMF, and members of the Salicaceae may be infected by both arbuscular and ectomycorrhizal fungi.

Hieracium umbellatum and *P. spurius* always occurred associated with AMF (Błaszkowski 1993a; Harley and Harley 1987a). In contrast, *L. arenarius* either has been mycorrhizal (Błaszkowski 1991a, 1993a) or autotrophic (Boullard 1963; Harley and Harley 1987a). Other plants revealed to be colonized by AMF were *C. arvensis, E. vulgare, E. angustifolium, H. pilosella, H. perforatum, K. glauca, L. japonicus* subsp. *maritimus, L. odora, M. caerulea* subsp. *arundinacea, P. arundinacea, P. lanceolata, R. rugosa, S. arenaria, V. cracca* and *V. tricolor*. However, they were sampled only once. Harley and Harley (1987a) listed *K. glauca* among non- mycorrhizal plants, and *E. angustifolium* and *L. japonicus* subsp. *maritimus* either have been associated with AMF (Dalpé 1989; Harley and Harley 1987a; Koske and Halvorson 1981; Koske and Tews 1987) or lacked mycorrhizae (Harley and Harley 1987a).

In this study, *A. stolonifera, A. arenaria, C. canescens, F. rubra* subsp. *arenaria, J. articulatus, J. balticus* and *M. pratense* either were mycorrhizal or non-mycorrhizal, supporting the numerous literature reports of facultative associations of these plants with AMF (Błaszkowski 1991a, 1993a, 1994c; Dalpé 1989; Pawłowska *et al.* 1996; Logan *et al.* 1989; Dominik 1951; Harley and Harley 1987a, 1990; Boullard 1963; Harley and Smith 1983; Dominik and Wojciechowska 1961).

Of the plant species investigated by the authors of this paper, only *J. conglomeratus, J. communis, P. sylvestris* and *P. erecta* did not harbour AM. In Błaszkowski's (1991a, 1993a) studies, roots of *J. conglomeratus* were non-mycorrhizal or only slightly infected by AMF, being, thereby, in agreement with the statement of Harley and Smith (1983) that members of the Juncaceae seldom associate with this group of fungi. Literature data and personal observations indicate that *J. communis* may grow with AM, ectomycorrhizal, ectendomycorrhizal fungi or autotrophically (Harley and Harley 1987ab; Błaszkowski 1991a, 1993a; Dominik 1951; Dominik and Wojciechowska 1961; Błaszkowski and Tadych pers. observ.). *Pinus sylvestris* is a host of ecto- and ectendomycorrhizal fungi (Harley and Smith 1983). According to Harley and Harley (1987a), *P. erecta* may form AM.

Soil chemical and physical properties

The chemical and physical properties of 97 randomly selected soil samples ranged: pH (in 1N KCl), 3.7-6.6; N-N0_3 (mgl^{-1}), 0.4-47.0; P, 0.0-65.0; K, 0.0-35.0; Ca, 0.0-2511.0; Mg, 0.0-44.0; Na, 0.0-19.0; Cl, 9.0-45.0; KCl, 15.0-160.0; orgC (%), 0.0-9.48; bulk density (kg L^{-1}), 0.35-1.55.

Acnowledgement. We would like to thank Professor R. E. Koske, Department of Biological Sciences, University of Rhode Island, USA for his helpful review of the manuscript and for providing many slides of arbuscular fungi to compare. This study was supported in part by The Committee of Scientific Researches, grant no. 6.P04C.015.13.

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MYCOTAXON

Volume LXXIV(2), pp. 483 April-June 2000

NOTES ON MYXOMYCETES FROM CHINA: TWO NEW NAMES

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ABSTRACT: *Trichia huizhongii* and *Physarum caesiellum nom. nov.* are proposed for the Myxomycetes *T. ramosa* Yu Li & H.Z.Li 1992 (*non* (Pers.) Mérat, 1821) and *P. caesium* Shuang L.Chen & Yu Li 1998 (*non* (Pers.) Mérat, 1829), respectively.

KEYWORDS. China, Myxomycetes, Myxomycota, nomenclature, slime molds

The names used to describe two Myxomycetes from China are found to be later homonyms; therefore, we propose the following new names.

Trichia huizhongii Chao-H.Chung & Tzean, ***nom. nov.***
Trichia ramosa Yu Li & H.Z.Li, Mycosystema 5: 175. 1992, *non Trichia ramosa* (Pers.) Mérat, Fl. Par. 2 ed., 1: 117. 1821 (≡ *Diderma ramosum* Pers. 1801 = *Reticularia stipitata* Bull.).
Notes: The species epithet is in memory of Hui-zhong Li (Institute of Microbiology, Chinese Academy of Sciences, Beijing), who found this species. Martin & Alexopoulos (1969) have proposed that *Reticularia stipitata* Bull. is probably a *Badhamia*.

Physarum caesiellum Chao-H.Chung & Tzean, ***nom. nov.***
Physarum caesium Shuang L.Chen & Yu Li, Mycosystema 17: 289. 1998, *non Physarum caesium* (Schumach.) Fr., Syst. Mycol. 3: 147. 1829 (≡ *Licea caesia* Schumach. 1803 = *Didymium difforme* (Pers.) Gray).
Notes: *Didymium difforme* is a plasmodiocarpous, sessile species, and thus is quite different from *Physarum caesiellum*.

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MYCOTAXON

Volume LXXIV(2), pp. 485-494 April-June 2000

NOTES ON HYPHOMYCETES. LXXVI. XYLOHYPHOPSIS AND WEBSTEROMYCES, TWO NEW DEMATIACEOUS, ACROPETALLY CATENATE GENERA

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ABSTRACT

Two new genera, *Xylohyphopsis* Baker & Partridge and *Websteromyces* Baker & Partridge, are established. The former is typified by the anamorphic fungus previously known as *Xylohypha curta* (Corda) S. Hughes [*Torula curta* Corda], while the latter accommodates a hithertofore undescribed species, *W. verruculosum*. *Xylohypha lignicola* Sutton is considered to be congeneric with *X. curta* and is, accordingly, also classified in *Xylohyphopsis*. All three occur on decorticated wood.

INTRODUCTION

Ongoing studies of dematiaceous Hyphomycetes occurring on woody substrates in southern Africa have led to the discovery of a number of novel taxa and some previously described but whose classification has been found to be in need of revision (Morgan-Jones, 1982; Morgan-Jones *et al.*, 1983; 1987a; 1987b; Sinclair *et al.*, 1987; Partridge *et al.*, 1999). Among those collected during the course of the last decade are two catenate entities, one originally described as *Torula curta* Corda, and another which we believe to be undescribed. We consider their respective uniqueness sufficient to warrant the naming of two new genera in which to classify them. Both are described and illustrated in this publication.

In reclassifying *T. curta* in the genus *Xylohypha* (Fr.) Mason, Hughes and Sugiyama (1972) recognized its similarity, in terms of some key hallmark characteristics, to the type species, *X. nigrescens* (Pers.) Mason. However, these authors (Hughes & Sugiyama, loc. cit.) noted the presence of apparently septate conidia following somewhat irregular chain disarticulation, leading to the qualifying statement being made that, notwithstanding this feature, the taxon "seems more suitably classified in *Xylohypha* than elsewhere". We are in agreement with what is presumably inferred; that is, *T. curta* is not entirely satisfactorily classified in *Xylohypha*. In addition to the matter of conidial septation certain other distinguishing characteristics clearly separate this species from *X. nigrescens*. These will be discussed in detail following the description provided below. Since there is no alternative genus available in which to classify this anamorph such is established herein.

TAXONOMIC PART

Xylohyphopsis Baker et Partridge, gen. nov.

Coloniae effusae, nigrae. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus compositum. Conidiophora micronemata, singula vel saepe caespitosa, cylindrica, pallide brunnea, laevia, adscendentia vel semiprostrata. Conidia sicca, in catenis simplicibus vel ramosis, acropetis formata, acropleurogena, doliiformia, aseptata vel septata, pallide vel medio brunnea, laevia, ad extremis truncatis.

Xylohyphopsis Baker & Partridge, gen. nov.

Colonies effuse, spreading widely or concentrated and localized, powdery with abundant conidial formation, dark brown to black. Mycelium mostly immersed in the substratum, composed of branched, septate, pale brown to brown, smooth hyphae. Conidiophores micronematous, essentially unmodified, emergent hyphae, single or in loose caespitose clusters, mostly flexuous, cylindrical or with individual cells slightly inflated, pale brown, smooth, ascending and more or less erect or semi-prostrate. Conidia dry, formed acropetally in simple or branched chains, acropleurogenous, barrel-shaped to ellipsoidal, aseptate or septate, where multicellular constricted at the septa, pale to mid brown, smooth, distinctly truncate at both ends upon disarticulation or obtuse at one end if terminal, tending to round off following detachment. Conidia seceding by either schizolytic splits occurring at septa or occasionally conidial units abstricting completely with no discernible transverse septum involved.

Etymology: *Xylohypha* et Gr. *opsis*, aspect.

Xylohyphopsis curta (Corda) comb. nov. (Figure 1)

≡ *Torula curta* Corda, Icon. Fung. 6: 5, 1854.

≡ *Xylohypha curta* (Corda) S. Hughes apud Deighton, Mycol. Pap. 78: 43, 1960.

= *Torula olivacea* Corda subsp. *inops* Karst., Hedwigia 29: 272, 1890.

Colonies effuse, spreading widely and thin or concentrated and localized forming a somewhat dense substratum, powdery with abundant conidial formation, dark brown to black. Mycelium mostly immersed in the substratum, composed of branched, septate, pale brown to brown, smooth, 2-5µm wide hyphae. Occasional hyphal cells slightly inflated. Conidiophores micronematous, essentially unmodified, emergent hyphae, merging gradually and subtly into conidial chains, single or in loose caespitose clusters, mostly flexuous, cylindrical or with individual cells slightly inflated, pale brown, smooth, ascending and more or less erect or semi-prostrate. Conidial chains often arising as lateral outgrowths of repent hyphae in close proximity to one another and frequently from adjacent hyphal cells. Conidia dry, formed acropetally in long, simple or, more rarely, branched chains, acropleurogenous, barrel-shaped to ellipsoidal, aseptate or septate, where multicellular constricted at the septa, pale to mid brown, smooth, distinctly truncate at both ends upon disarticulation or obtuse at one end if terminal, tending to round off following detachment, becoming uniformly somewhat thicker-walled with maturity and very slightly roughened. Conidial size varying depending upon number of unit cells; when unicellular 6.5-8 x 5-6.5µm. Chains breaking up readily into zero to four, or more, septate conidia. At the time of secession polar truncation broad, flat, 3-4µm wide. Conidia seceding by either schizolytic splits occurring at septa or occasionally conidial units abstricting completely with no discernible transverse septum involved.

On decaying wood, Mont-Aux-Sources, Royal Natal National Park, Republic of South Africa, 16 January 1992, G. Morgan-Jones, AUA.

The decision to establish a new generic name for this taxon is based upon the presence of several fundamental differences between it and *Xylohypha* sensu stricto. In *X. nigrescens* and such other species as *X. ferruginosa* (Corda) S. Hughes, *X. novae-zelandiae* S. Hughes & Sugiyama, and *X. palmicola* S. Hughes & Sugiyama, the units of the moniliform conidial chains are invariably connected by only a very narrow isthmus, there being no broad transverse septum involved in the compartmentalization process. Each successive conidium arises as a bud which originates at a minute terminal conidiogenous locus on the preceeding unit, and is ultimately pinched off in essentially a yeast-like manner. As a result, the constriction between each conidium is extremely accentuated and the chains consistently fall apart as single-celled units. As *Xylohypha* conidia mature, their walls thicken differentially, the small connective zone between each conidium remaining rather thinner than the periclinal circumference area. In contrast, the conidial units of *Xylohyphopsis curta* are separated by broad transverse septa which thicken equivalently relative to the lateral walls. In the process of disarticulation the distinct, wide septa cleave schizolytically.

Xylohyphopsis curta appears to be cosmopolitan in distribution and somewhat varied in its substrate association. In addition to the collection from South Africa reported herein, this species has been encountered in Canada on unidentified rotten wood (Hughes and Sugiyama, loc. cit.). The name *Torula olivacea* Corda subsp. *inops* was based on a specimen of this fungus found on pine wood in Finland and the Corda type material extant in the Prague herbarium (PR) is on wood of *Quercus* (Hughes and Sugiyama, loc. cit.).

Sutton (1973) named and described *Xylohypha lignicola* Sutton, a fungus which appears to be closely similar to *X. curta*. It produces comparable chains of conidia, each unit being separated by a broad transverse septum. However, Sutton (loc. cit.) noted that the chains do not readily break up, and when they do each resulting conidium is invariably unicellular. At the time of detachment the conidia were described as being truncate at each end but later becoming subglobose to globose. Although of a similar size to those of *X. curta*, the conidia of *X. lignicola* are dark brown, thick-walled, and verrucose at maturity. Notwithstanding these small differences, we believe *X. lignicola* to be congeneric with *X. curta* and therefore the following new combination is proposed: *Xylohyphopsis lignicola* (Sutton) Baker & Partridge, comb. nov. [basionym: *Xylohypha lignicola* Sutton, Mycol. Pap. 132: 126, 1973].

Websteromyces Baker et Partridge, gen. nov.

Coloniae extense effusae, atrobrunneae vel nigrae, densae, pulveraceae. Mycelium in substrato immersum, ex hyphis ramosis, brunneis, septatis, laevibus compositum. Conidiophora semi-macronemata, singula vel

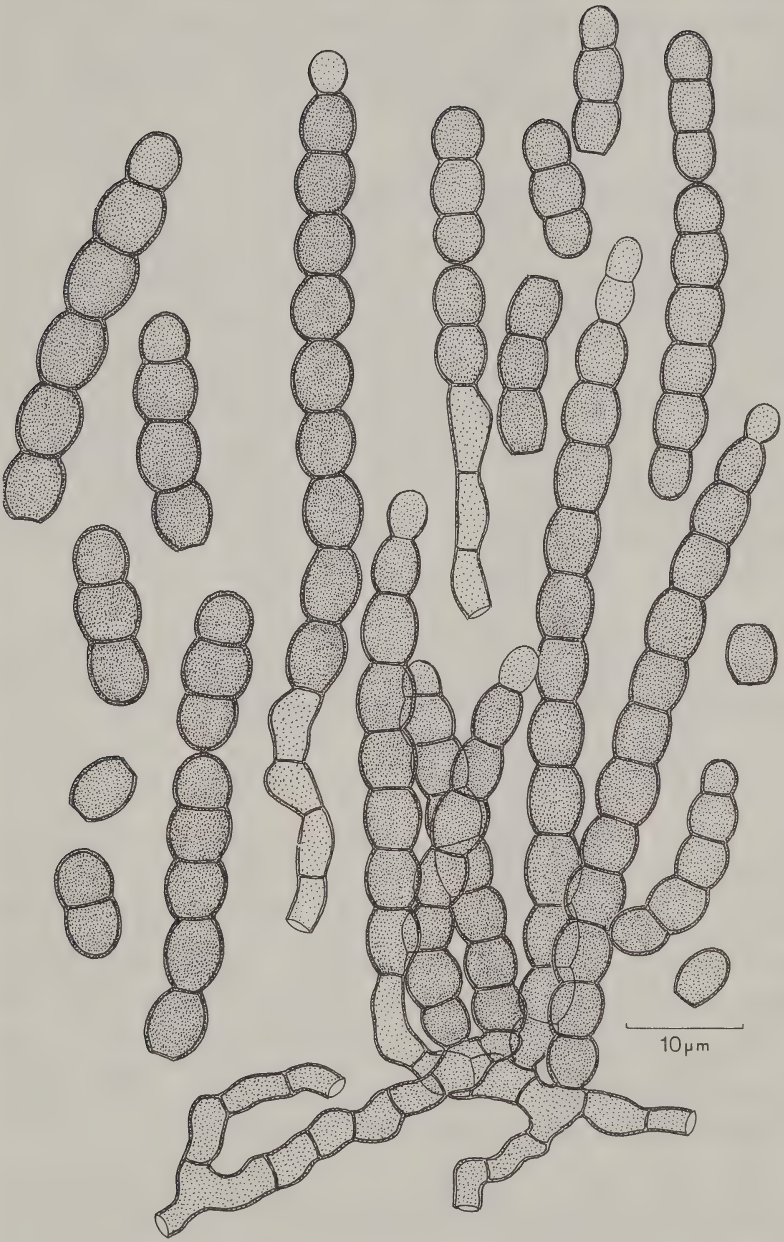

FIGURE 1. *Xylohyphopsis curta*. Conidiophores and conidia.

plerumque caespitosa, adscendentia, erecta vel flexuosa, simplicia vel interdum ramosa, cylindrica, pallide brunnea vel brunnea, laevia, apicem versus verruculosa. Conidia sicca, in catenis simplicibus vel ramosis, acropetis formata, acropleurogena, ellipsoidea vel leniter clavata, aseptata vel 1-2-septata, brunnea, dense verruculosa.

Websteromyces Baker & Partridge, gen. nov.

Colonies extensively effuse, spreading as irregular tufts, at first more or less orbicular, later becoming confluent, dark brown to black, dense, appearing when fully developed as powdery, sooty patches. Mycelium mostly immersed in the substrate, composed of branched, brown, septate, smooth hyphae. Conidiophores semi-macronematous, little modified from the hyphae, broader and somewhat verruculose distally, otherwise smooth, solitary or, more frequently, densely caespitose, ascending, more or less straight or slightly flexuous, simple or sometimes bearing short lateral branches, cylindrical, pale brown to brown. Conidia dry, in simple or branched chains, forming acropetally, acropleurogenous, ellipsoid to somewhat clavate, unicellular or 1-2-septate, brown, densely verruculose.

Etymology: this genus is named in honor of Professor John Webster, University of Exeter, England, who collected the type specimen, in respectful recognition of his many distinguished contributions to mycology.

Websteromyces verruculosum Baker et Partridge, sp. nov.

Coloniae extense effusae, atrobrunneae vel nigrae, densae, velutinae, pulveraceae, discretae vel interdum coalescentes, orbiculares vel irregulares. Mycelium in substrato immersum, ex hyphis ramosis, brunneis, septatis, laevibus vel verruculosis, 2.5-4μm crassis compositum. Conidiophora semi-macronemata, singula vel plerumque caespitosa, adscendentia, erecta vel flexuosa, simplicia vel interdum ramosa, cylindrica, pallide brunnea vel brunnea, laevia, apicem versus verruculosa, usque ad 90μm longa, 3.5-5μm crassa. Conidia sicca, in catenis simplicibus vel ramosis, acropetis formata, acropleurogena, ellipsoidea vel leniter clavata, aseptata vel 1-2-septata, brunnea, dense verruculosa, 6-10μm longa, 4-5μm crassa.

In ligno emortuo, Mankwe Dam, Pilansberg Nature Reserve, Bophuthatswana, Republic of South Africa, 11 July 1991, J. Webster, AUA, holotypus.

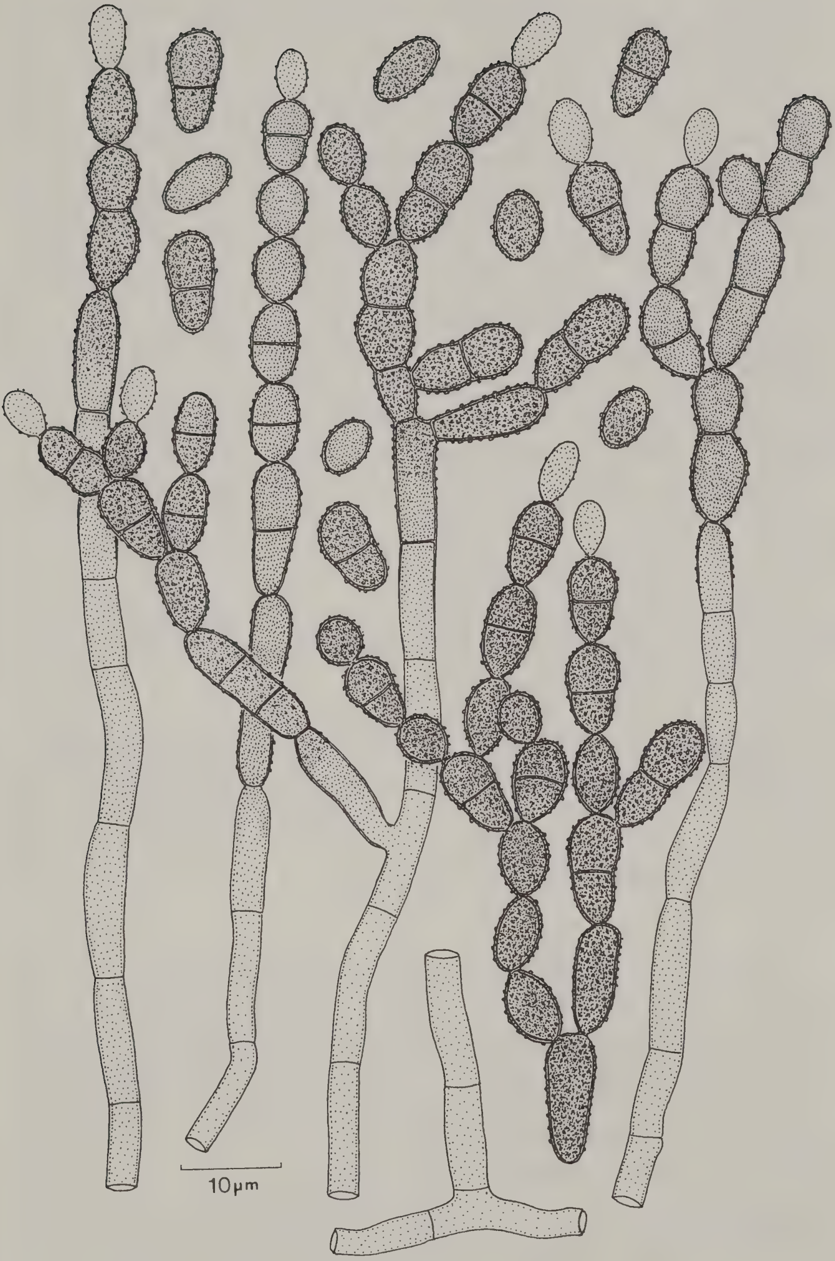

FIGURE 2. *Websteromyces verruculosum*. Conidiophores and conidia.

Websteromyces verruculosum Baker & Partridge sp. nov. (Figure 2)

Colonies extensively effuse, spreading as irregular tufts, at first more or less orbicular, later becoming confluent, dark brown to black, dense, velvety, appearing when fully developed following conidiation as powdery, sooty patches. Mycelium mostly immersed in the substrate, composed of branched, very pale brown to brown, septate, smooth or occasionally finely verruculose, 2.5-4μm wide hyphae. Conidiophores semi-macronematous, little modified from the hyphae, broader and somewhat verruculose distally, otherwise smooth, or verruculose over much of their length, solitary or, more frequently, crowded and densely fasciculate, ascending, more or less straight or slightly flexuous, simple or sometimes bearing short lateral branches, cylindrical, pale brown to brown, up to 90μm long, 3.5-5μm wide. Conidia dry, in simple or branched chains, forming acropetally, acropleurogenous, ellipsoid to somewhat clavate, unicellular or frequently bicellular, rarely 2-septate, where 1-septate with the distal cell often slightly larger than the other, brown, densely verruculose, becoming relatively thick-walled at maturity, 6-10μm long, 4-5μm wide.

On dead, decorticated, submerged branch of unidentified tree, Mankwe Dam, Pilansberg Nature Reserve, Bophuthatswana, Republic of South Africa, 11 July 1991, J. Webster, AUA, holotype.

Although a number of genera having acropetally catenate conidia of morphologically similar aspect have been recognized, such as *Cladosporium* Link, *Websteromyces* is distinct in a number of respects. The absence of any cicatrization, the degree of abstriction between each conidial unit, and conidium ornamentation are among characteristics which make this genus singularly unique.

The fungus *Alysidium minus* (Castañeda) Castañeda & Kendrick, originally named *Cladosporium minus* Castañeda, has a broadly similar morphology, but it is uncertain whether this taxon, because of the presence of what appear to be distinct conidiogenous denticles, is closely related to *W. verruculosum.* It is conceivable, however, that it might be appropriately transferred to *Websteromyces*. It seems very doubtful that *A. minus* is satisfactorily classified in the genus *Alysidium* Kunze, not only on account of this name being now considered a synonym of *Haplotrichum* Link. A reevaluation of its classification and that of several other species currently placed in *Alysidium* is needed. Among these are *A. guttulatum* Castañeda, *A. pinarense* Castañeda & Kendrick, and *A. resinae* (Fr.) M.B. Ellis, including *A. resinae* var. *microsporum* Sutton. Such taxa are doubtfully related to species of *Haplotrichum*, a genus based on the anamorphs of *Botryobasidium* Donk, which produce hyaline or straw-colored conidia and will, therefore, need to be transferred elsewhere, possibly to one or more additional new genera. The type species of *Alysidium* is the anamorph of *Botryobasidium aureum* Parmasto and a number of binomials have, historically, been applied to it, including *A. fulvum* Kunze, *A. dubium* (Pers.) M.B. Ellis [*Trichoderma dubium* Pers.], and *Haplotrichum aureum* (Pers.) Hol.-Jech. [*Acrosporium aureum* Pers.]. In a revision of *Haplotrichum*, Holubová-Jechová (1980) adopted the name *H. aureum* but *T. dubium* is the first binomial applied to this species. The same author (Holubová-Jechová, 1976) had taken up the genus *Haplotrichum* Link for anamorphs of *Botryobasidium* on the basis of the fungal nomenclature starting-point date provisions of the International Rules of Botanical Nomenclature existing at that time. Following the enactment of changes in the ICBN made in 1981, however, the generic name *Acladium* Link [Mag. Ges. naturf. Freunde, Berlin, 3: 11, 1809] takes priority precedence over *Haplotrichum* and the valid name for the anamorph on which the generic name *Alysidium* is based is thus now *Acladium dubium* (Pers.) S. Hughes. In order to appropriately revise the nomenclature of these anamorphs, other taxa transferred by Holubová-Jechová (1976) will probably need to be reassigned to *Acladium*. Relative to *A. pinarense*, Castañeda & Kendrick (1990) offer the observation that darkly pigmented species of *Alysidium* and *Alysidiopsis* Sutton may eventually be redisposed in *Cladosporium*. We consider this to be highly unlikely, however, because of the absence of distinctly thickened conidial scars in the former genera. On the contrary, *Alysidiopsis* appears to be a perfectly good genus. These taxa clearly do not belong in *Cladosporium*.

ACKNOWLEDGMENTS

One of us (G.M.-J.) acknowledges with gratitude the opportunity to collect microfungi in South Africa afforded through the good offices of Professor Albert Eicker, Department of Botany, University of Pretoria. We appreciate being allowed the privilege of studying the collection made by Professor John Webster. We thank Dr. J. Leland Crane, Illinois Natural History Survey, Champaign, for reviewing the manuscript.

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MYCOTAXON
Volume LXXIV(2), pp. 495-498 April-June 2000

ON THE SPORE WALL OF ECHINOSTELIUM ELACHISTON (MYXOMYCETES)

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Summary

Spores of *E. elachiston* are warted; warts usually grouped in clusters, then giving the impression of thickening pads by transmitted light. These clusters of warts might be the precursors of the typical thickened pads found in some species of the genus.

Echinostelium elachiston Alexop. is a scarcely a collected species. It is only known from a few localities in Greece (Alexopoulos, 1958), USA (Martin & Alexopulos, 1968; Whitney, 1980), Britain (Ing, 1999), France (Mitchel & al., 1984), Turkey (Härkönen) and Spain (Champion, 1983; Oltra & Pando, 1998; Pando, 1997).

Spore wall structure is a character of taxonomic and phylogenetic relevance. It splits the genus in two groups, one with spore wall of uniform thickness and the other with thickened articular surfaces (sometimes referred as "thickened pads") on the spore wall. The elucidation of the actual structure of the spore wall in *E. elachiston* is especially important since because of its simplicity, it occupies a basal position in the evolution of the group and its good characterization is essential for a reliable interpretation of the evolution of the group.

The question of whether the spores of *E. elachiston* have thickened articular surfaces or not has remained open until today. Alexopoulos (1958: 52) in the protologue states that spore are "globose, typically golden yellow, smooth but with well-marked thin places on the wall," and later (Martin & Alexopoulos, 1968: 98), as "smooth, but with well-marked circular areas on the wall". On the other hand, Whitney (1980: 967) describes its spores as "minutely roughened, lacking articular surfaces." The available illustrations, provided in the cited works (Alexopoulos, 1958: 53; Martin & Alexopoulos, 1968: plate VI fig. 58; Whitney, 1980: 968 figs. 19-27), are equally non-conclusive.

Some of the specimens recently found in Spain held numerous well-mature sporocarps. This allowed us to prepare some samples for S.E.M.

observation using the "critical point" technique. What the S.E.M. pictures revealed was that the spores surface are covered by warts irregular in shape and size which, in some cases, appear in clusters (Fig.1, 2), giving so the impression that they are thickened pads. To set our observations of a firm ground we studied almost all the available specimens collected worldwide. We found that some specimens identified as *E. elachiston* belonged in fact to other species (UTMC-1346, GR-228 —cited in the protologue). In other cases, immature specimens might lead to the impression that *E. elachiston* shows smooth spores. Spores of immature specimens characteristically remain firmly attached to sporocarps. That was the case of specimens GR-9-60, TEB #2602, TEB #2640, GR-64-1. It is possible that these specimens even belong to *E. colliculosum* K.D. Whitney & H.W. Keller or *E. coelocephalum* T.E. Brooks & H.W. Keller. Preparation of additional microscope slides, and S.E.M. samples would be needed to secure the identification, but this would compromise the integrity of the herbarium specimens.

We conclude that the spores of *E. elachiston* are warted, in some specimens coarsely warted; warts regularly distributed or more characteristically grouped in clusters, then giving the impression of forming pads by transmitted light. These clusters of warts might be the precursors of the typical thickened pads found in some species of the genus. In the case of immature sporocarps, the wide collar (9-20 μm vs. less than 8 μm in diam) and the thick stalk (4-5 μm vs. 1.5-3 μm in diam) are useful character to separate this species from the close *E. colliculosum and E. coelocephalum.*

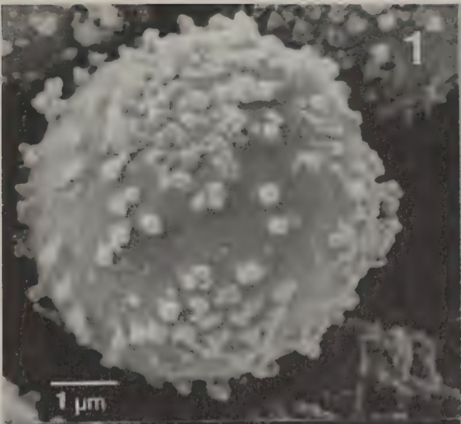
Acknowledgements

We thank the BPI curators for lending specimens of *E. elachiston*. We also appreciate the kindness of Mr. David. K. Mitchell for allowing to study his collection. This paper is partially supported by the Spanish government through the DGES grant (PB95-0129-C03-01) to the *Flora Mycologica Iberica* project.

Collections examined:

Echinostelium coelocephalum T.E. Brooks & H.W. Keller
USA: Colorado: Boulder, On bark of Ulmus in moist chamber, UTMC-1346, BPI 819092 [as *Echinostelium elachiston* Alexop.].

Figs. 1-6. *E. elachiston*. 1-2. Spores with critical point method by SEM; some warts are grouped in clusters. 3. Top of sporocarp by SEM: spores, collar and tip of stalk. 4-5. Spores by transmitted light (Oltra 1813, MA-Fungi 38578). 6. Spores by transmitted light (GR-194 BPI 819066; Holotypus). 7. *E. coelocephalum*. Spores by transmitted light (UTMC-1346, BPI 819092). 8. *E. collicolosum*. Spores by transmitted light (GR 228, BPI 819076).
–For comparison , figs. 1-2 are at the same scales, as well as figs. 4-8.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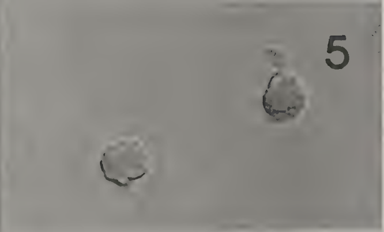
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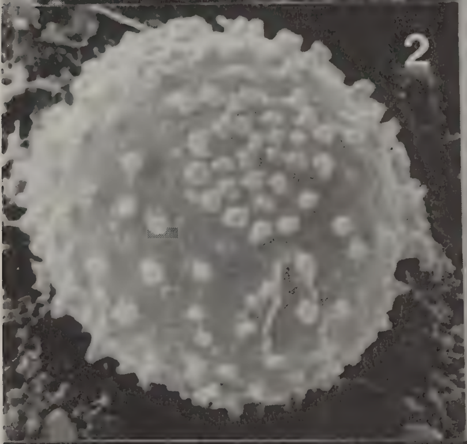
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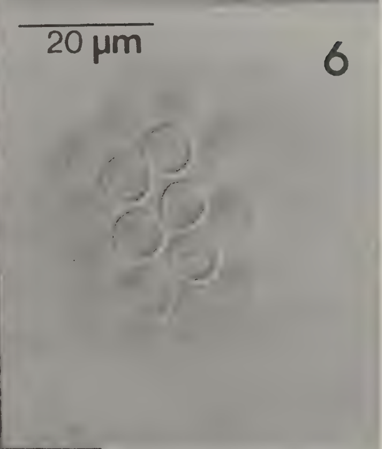
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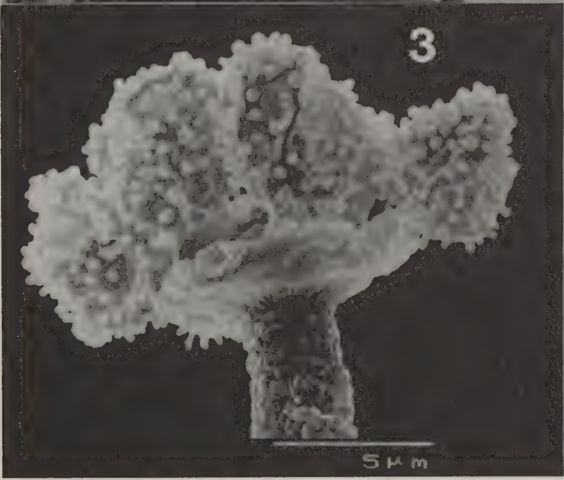
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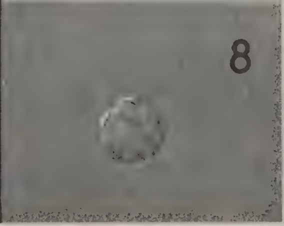
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Echinostelium colliculosum K.D. Whitney & H.W. Keller

GREECE: Marathon, Attica, bark of *Cupressus sempervirens* in moist chamber, 19-III-1955, GR-228, BPI 819076 [as *Echinostelium elachiston* Alexop.].

Echinostelium elachiston Alexop.

FRANCE: Dordogue, Abre de la Liberté, en Tilia bark, 3-VIII-1981, DWM 3734.

GREECE: Astypalaia island, *Juniperus phoenicia*, I-1955, GR-213, BPI 805663 [probably, *E. coelocephalum*; small collar]. Knossos, Creta, On bark of *Cupressus sempervirens* in moist chamber, 25-VI-1964, UTMC-243, BPI 819079 [immadure]. Olimpia, Elis, moist chamber, bark of *Acer*, 15-IV-1955, GR-229, BPI 819091. Tempe-Stomion rd. Thessaly, moist chamber, bark of *Platanus orientalis*, 13-X-1954, GR-194, BPI 819066 [Typus]. Kaisarioni, Attica, developed in moist chamber on bark of *Robinia pseudoacacia* (?), 4-VIII-1960, GR-9-60, BPI 819086 [immature].

SPAIN: Guadalajara; Anquela del Ducado, 30TWL7337, 1200 m, corteza de *Quercus faginea* developed in moist chamber, 16-X-1987, 551 Pando, MA-Fungi 22536. Orea, junto a la ctra. de Orea a Orihuela del Tremedal, 30TXK1990, 1600 m, bark of *Juniperus sabina* in moist chamber, 21-X-1987, 557-1 Pando, MA-Fungi; *ibidem*, 24-X-1987, 557-2 Pando, MA-Fungi 225422; *ibidem*, 15-X-1987, 555 Pando, MA-Fungi 22540. Anquela del Ducado, 30TWL7337, 1200 m, On bark of *Quercus faginea*, 16-X-1987, Pando 551, MA-Fungi 22536. Orea, near road from Orea to Orihuela del Tremedal, 30TXK1990, 1600 m, On bark of *Juniperus sabina*, 21-X-1987, Pando 557-1, MA-Fungi 22542; *ibidem*, 24-X-1987, Pando 557-2, MA-Fungi 22542. Valencia; Gandía, Playa del Grao de Gandía, paseo marítimo, 30SYJ4521, 1 m, on *Phoenix canariensis*, 4-X-1996, 1813. Oltra, MA-Fungi 38578.

USA: Kansas; Johnson Co., on peach bark in moist chamber, 25-XI-1963, T.E. Brooks #2602, BPI 819073 [immature]; *ibidem*, en On elm in bark in moist chamber, 13-IV-1964, T.E. Brooks 2640 [immature], BPI 819070; *ibidem*, en On bark of living *Juniperus virginiana* in moist chamber, 15-IX-1964, TEB 2683, BPI 819081. Missouri: Cape Girardeau, On sweetgum bark in moist chamber, 20-III-1968, TEB 3381, BPI 819089.

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MYCOTAXON

Volume LXXIV(2), pp. 499-503 April-June 2000

TWO NEW SPECIES OF XANTHOPARMELIA (LICHENIZED ASCOMYCOTINA, PARMELIACEAE) FROM AUSTRALIA CONTAINING NORLOBARIDONE

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ABSTRACT: *Xanthoparmelia crespoae* Elix, Louwhoff & Molina and *X. microphyllizans* Elix are described as new to science.

Introduction

As a result of a continuing study of the lichen genus *Xanthoparmelia* in Australia (Elix 1994, 1999; Elix & Kantvilas 1999), we are describing a further two new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), high performance liquid chromatography (Elix *et al.* 1997; Feige *et al.* 1993) and comparison with authentic samples.

Xanthoparmelia crespoae Elix, Louwhoff & Molina, sp. nov. Fig. 1

Thallus ut in *Xanthoparmelia incrustata* sed superfice superiore effigurato-maculata differt.

Type: Australia. New South Wales, Shoalhaven River, Warri Bridge, *ca.* 15 km NW of Braidwood, 35°21'S, 149°44'E, 600 m, on granite rocks in *Leptospermum-Acacia* dominated scrub, *J. A. Elix 30295,* 22 Sep. 1999; holo: CANB; iso: HO, MEL.

Thallus foliose, moderately adnate to adnate, forming extended colonies to 20 cm wide. *Lobes* densely imbricate, ±forming a rather thick, dense mat, sublinear to subirregular, subdichotomous to subirregularly branched, 1.0-1.2 mm wide; developing narrower (0.2-1.0 mm), sublinear-elongate, subdichotomous to trichotomously branched, ±clustered, torulose to subterete laciniae. *Upper surface* yellow green, mostly flat, dull, distinctly to effigurately maculate, smooth or rarely cracked, lacking isidia and soredia. *Medulla* white. *Lower surface* ivory to pale brown, often darkening towards the lobe apices; some laciniae canaliculate; rhizines sparse, simple, concolorous. *Apothecia* and *pycnidia* not seen.

Chemistry. Cortex K-, medulla K-, C-, KC+ orange-pink, P-; containing usnic acid (major), norlobaridone (major), loxodin (minor).

This species is characterized by the moderately adnate, foliose thallus which forms extended, dense mats, the narrow, imbricate lobes with a distinctly to effigurately maculate upper surface, a pale lower surface, the absence of isidia and the presence of loxodin and norlobaridone in the medulla. In overall morphology this species resembles *Xanthoparmelia incrustata* (Kurok. & Filson) Elix & J.Johnst., but the latter species is more tightly adnate, often becomes areolate in the centre, has an emaculate upper surface and develops convex marginal lobes as well as laciniae with a canaliculate lower surface. *Xanthoparmelia crespoae* could be confused with the chemically identical, maculate species *Xanthoparmelia metamorphosa* (Gyeln.) Hale, but the latter species is distinguished by having a loosely adnate thallus, much narrower (0.2-0.6 mm cf. 1-1.2 mm wide), dichotomously branched, divaricate lobes (not dense and mat forming) with a weakly white-maculate upper surface. At present this species is known only from the type locality where it is quite common. This species is named in honour of the noted Spanish lichenologist, Professor Ana Crespo.

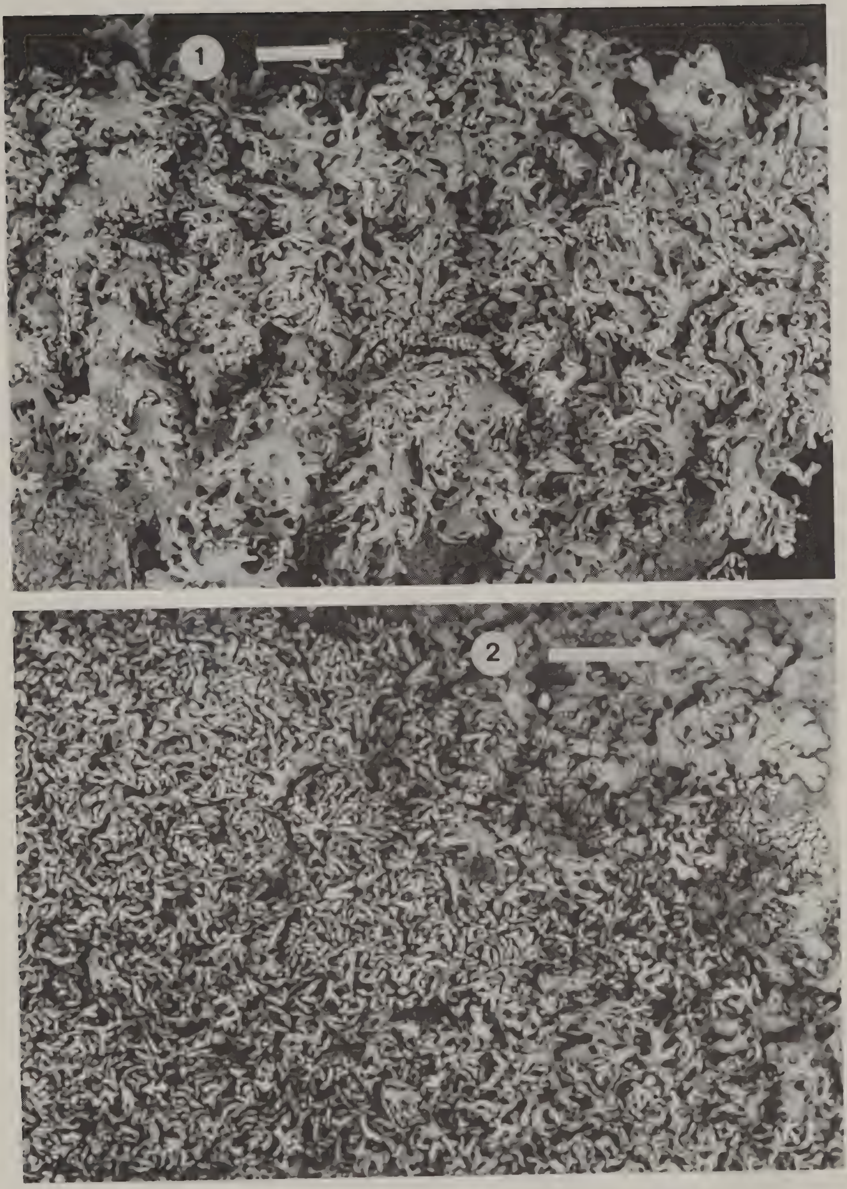
Paratype Specimens Examined

AUSTRALIA. New South Wales, type locality, *J. A. Elix 42680*, 17.i.1998 (CANB); Shoalhaven River, 100-200 m downsteam from Warri Bridge, *ca.* 15 km NW of Braidwood, 35°21'S, 149°44'E, 600 m, on granite rocks in *Leptospermum-Acacia* dominated scrub, *J. A. Elix 30299*, 22.ix.1999 (CANB); *S. H. J. J. Louwhoff 1110, 1114, J. A. Elix & M. C. Molina*, 22.ix.1999 (CANB), *S. H. J. J. Louwhoff, M. C. Molina 67, 86, 103 & J. A. Elix*, 22.ix.1999 (MD).

Xanthoparmelia microphyllizans Elix, sp. nov. Fig. 2

Thallus ut in *Xanthoparmelia filarszkyana* sed lobis laciniatibus vel lobulatibus differt.

Type: Australia. Tasmania: Deal Island, Kents Group, Bass Strait, summit, *ca.* 500 m NE of Lighthouse Hill, 195 m, on exposed granite rocks, *John Whinray 2741*, 6 Nov. 1992; holo: MEL; iso: CANB.



Figures 1-2. New species of *Xanthoparmelia*: 1, *X. crespoae* (holotype in CANB); 2, *X. microphyllizans* (holotype in MEL). Scale bar = 5 mm.

Thallus foliose, tightly adnate, to 15 cm wide. *Lobes* imbricate, flat, sublinear to irregular, irregularly branched, 1-3 mm wide; apices of the marginal lobes subrotund; margins ±laciniate-dissected; at the centre developing densely imbricate, mat-forming, sublinear-elongate, microphylline laciniae, 0.1-0.5 mm wide. *Upper surface* yellow-green, darkening with age, dull in centre but shiny at lobe apices, emaculate, margins blackened, without isidia or soredia. *Medulla* white. *Lower surface* flat, smooth, ivory to brown, darkening at the lobe apices; rhizines sparse, simple, short, coarse, dark brown or black. *Apothecia* not seen. *Pycnidia* common, immersed. *Conidia* bifusiform, 6-7 x 0.7-1 μm.

Chemistry. Cortex K-, medulla K-, C-, KC+ orange-pink, P-; containing usnic acid (major), norlobaridone (major), loxodin (minor).

This species is characterized by the tightly adnate foliose thallus, the densely imbricate, microphylline laciniae, the pale lower surface, the absence of isidia, and the presence of loxodin and norlobaridone in the medulla. The primary lobes of *X. microphyllizans* resemble those of *X. filarszkyana* (Gyeln.) Hale as both have marginal lobes with subrotund apices, lack isidia, have a pale lower surface and identical chemistry. However, *X. filarszkyana* lacks laciniae whereas *X. microphyllizans* is densely laciniate. *Xanthoparmelia microphyllizans* could also be confused with the chemically identical species, *X. flavescentireagens* (Gyeln.) D. J. Galloway, but the latter species is distinguished by having a loosely to moderately adnate thallus which lacks microphylline laciniae. When laciniate, *X. flavescentireagens* develops much broader (0.8-1.5 mm wide), sublinear-elongate, ±weakly canaliculate laciniae. At present this species is known only from the type locality where it is apparently quite common.

ACKNOWLEDGEMENTS

We wish to thank the Australian Research Council for financial support of this project, Mr Stuart Hay and Mr Neal McCracken of the Photographic Unit, ANU, for preparing the photographs. This research was made possible by a Postdoctoral Fellowship (to MCM) from the Comunidad Autonoma de Madrid (BOCM, 27 January, 1999).

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MYCOTAXON
Volume LXXIV(2), pp. 505-506 April-June 2000

FIRST REPORT OF ANTHOSTOMELLA PEDEMONTANA FROM NORTH AMERICA

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Abstract

Anthostomella pedemontana is reported from pine foliage in Oregon.

Discolored foliage of *Pinus sylvestris* L. grown for Christmas trees in a plantation in Southwest Oregon was referred to the Oregon State University Plant Clinic for examination and diagnosis in late March 1996. Attached, browned needles mainly bearing immature *Lophodermium pinastri* (Hook.) Chev. were observed. An inconspicuous fungus with immersed perithecia, associated with pale bands in the needles was also present. This fungus proved to be a species of *Anthostomella* Sacc., and was apparent only from a slight deformation of the needle surface where a slightly protruding papilla emerged, often surrounded by a halo of expelled brown ascospores.

The specimen agreed in all respects with the description of *A. pedemontana* Ferr. & Sacc. provided in Francis (1975). In particular, this species is distinguished by having asci lacking an apical ring and unicellular, oval to ellipsoidal ascospores with a symmetrical hyaline sheath and prominent, central, straight germ slit only about one-half the length of the spore.

This fungus has previously been recorded from the same host in Italy and from *P. wallichiana* A.B. Jackson from Pakistan (Francis 1975). To our knowledge this is the first report of its occurrence in the United States or North America. One other species of *Anthostomella*, *A. formosa* var. *abietis* J. D. Rogers et al. also has been reported from conifer foliage (*Abies procera* Rehd.) grown for Christmas trees in Oregon (Rogers et al. 1994). The other records of *A. pedemontana* are from apparently naturally abscised needles.

Ascospores of *A. pedemontana* germinated on malt and potato dextrose agar, and produced a white, cottony culture on both media. At 25 C, growth was relatively rapid, 7.5 cm in seven da. No conidial anamorph was produced in cultures after several months. A culture of *A. pedemontana* from germinated ascospores has been deposited with ATCC (ATCC 200583) and a specimen was deposited in the Oregon State University Herbarium (OSC 67860).

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Francis, S. M. 1975. *Anthostomella* Sacc. (Part I). Mycological papers 139. CMI, Kew, UK. 97 p.

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MYCOTAXON

Volume LXXIV(2), pp. 507-514 April-June 2000

BOOK REVIEWS AND NOTICES[1]

Compiled by
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In taking on the responsibility for this section of *Mycotaxon,* my aim is to provide systematic mycologists with prompt information of new titles that may be of interest to them. In order to achieve this goal, and recognizing that some works will be of wider interest than others, the section will comprise a mixture of detailed reviews and shorter notices arranged under series of broad headings. These will include not only items sent submitted by publishers and authors for this purpose, but further other works that come to my attention. In general, only titles published within the previous twelve months will be included. The value of the series will depend on publishers, editors, and authors submitting material promptly on publication. If you have generated a work that you would like to see covered in these pages, ensure a copy is dispatched to my office as soon as possible. Also, if you would like to review a book not yet featured here do let me know, even if it has not been submitted by the publisher for that purpose. I am anxious that works of value in systematic mycology in the broadest sense from societies, small publishers, and in serial publications are not overlooked.

I also wish to acknowledge and thank my predecessor in this role, Eric McKenzie, first on behalf of all *Mycotaxon* readers for his period of stewardship, and second personally for effecting a smooth hand-over of responsibilities.

GENERAL

Italians in the History of Mycology. Edited by Silvano Onofri, Antonio Graniti & Laura Zucconi. 1999. Mycotaxon, P. O. Box 264, Ithaca, NY 14851-0264, USA. Pp. 163. ISBN 0 930845 09 9. Price not indicated.

The proceedings of a symposium held in Rome on 4-5 October 1995 held under the auspices of the Società Botanica Italiana, paying tribute to the enormous contributions Italians have made to mycology from the sixteenth century onwards, but with some references going back to the sixth century. The fourteen chapters cover pioneers such as Micheli, De Notaris, Saccardo, Bresadola, Tassi, Mattirolo, and Ciferri. Attention is also given to internationally lesser known Italian mycologists such as Inzenga, Carmignani, Archangeli, and Pellegrini. In addition there are accounts of the mycological collections in Rome and Genoa.

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[1] Books for consideration for inclusion in this column should be sent to the Book Review Editor in the first instance: David L. Hawksworth, MycoNova, 114 Finchley Lane, Hendon, London NW4 1DG, UK; tel/fax [+44] (0) 20 8203 4282; e-mail myconova@btinternet.com. Unsigned reviews and notices are by the Book Review Editor.

An enjoyable, fascinating, and beautifully illustrated book with copies of illustrations, many in colour, and also of manuscripts, specimens, and labels as well as portraits. The illustrations include one of *Elaphomyces granulatus*, dated to 512 AD based on Dioscorides' *De Natura Medica* of the first century; Dioscorides was Greek but a physician to Nero's Asiatic legions. Some early illustrations were somewhat imaginative in part, for example that of Aldovandi's sixteenth century plate of *Phallus impudicus,* and Dodoens' 1616 portrayal of the same fungus, but others were faithfully executed, as that of a truffle in Cesi's late sixteenth century *Codex*.

In a volume of its size, it was inevitable that full recognition of all Italian workers could not be given. Personally, I would have liked to see even more attention given to work by Micheli, De Notaris and Saccardo, including their impacts on the systems for lichen-forming fungi. For example, Micheli's first illustration of asci ever (in *Pertusaria*) and how Linnaeus' work took lichenology backwards how: De Notaris' recognition of the importance of spore types stimulated the work of the Italians Massalongo and Trevisan in revising generic concepts in the 1850s-1870s; and Saccardo's mechanistic system permeated the work of Nylander and Zahlbruckner and eclipsed work whose rediscovery had to await the 1970s-1980s.

What is especially gratifying is the interest and respect that Italian mycologists have in their history. There have been separate symposia devoted to the achievements of Saccardo and Ciferri held in 1995 and 1997 respectively, the first published in 1998 and part of the second in 1999. In addition, there have been Italian reprints of selected works by De Notaris issued in 1990, by Massalongo in 1991, and of Trevisan in 1994. It is to be hoped that more of Micheli's unpublished work will also eventually become available - as alluded to in this volume.

Scientists always sit on the shoulders of their forebears, and this is especially true for systematists. Personally, I continue to be amazed at what has been observed and the insights that can be obtained from reading work from the past. Volumes such as this provide an *entrée* into a body of knowledge that is in danger of being lost at a time when researchers are increasingly reliant on what is available through electronic databases. It is great that Mycotaxon Ltd has decided to make the proceedings of this symposium more widely available. If you can obtain a copy I am confident you will enjoy it as much as I did.

Russian Arctic Fungi. By I. V. Karatygin, E. L. Nezdoimingo, Y. K. Novozhilov & M. P. Zhurbenko. 1999. Komarov Botanical Institute, St Petersburg. Pp. 212. [In Russian with English alternative title page and Preface.] ISBN 5 8085 0058 3. Price not indicated.

A summary of the fungi known from the Russian arctic. The 1750 species treated cover slime-moulds, oomycetes, macromycetes, ascomycetes, and mitosporic conidial fungi. Lichenicolous fungi are included, but not lichens, soil fungi and yeasts; this somewhat eclectic approach will have to be borne in mind when using this as a checklist or for comparative studies with different regions. The taxa are arranged by the 8th edition of *Ainsworth & Bisby's Dictionary of the Fungi,* and records, according to 13 geographic regions, and with references either to collections in LE or to published reports. Notes on the occurrence of treated species in other arctic regions (e.g. Alaska, Canada, Fennoscandia, Greenland, Spitsbergen) are appended. The work comes with a "health warning" that many identifications may be wrong. Such checklists are a key step in getting to grips with the mycobiota of an area, and I am sure the compilation will be of value to all trying to identify fungi from the Russian arctic.

TECHNIQUES

Molecular Fungal Biology. Edited by R. P. Oliver & M. Schweizer. 1999. Cambridge University Press, Cambridge CB2 2RU, UK. Pp. x + 388. ISBN 0 521 451167, Hardback, Price: £57.50. ISBN 0 521 56784X, Paperback, Price: £21.95.

Molecular biology pervades increasingly diverse aspects of mycology. This book endeavours to provide an introduction to its multifarious applications. The topics covered range from phylogeny to results from yeast genome sequencing, and sexual development to lignocellulose breakdown, phytopathology and biotechnology. The authors are generally well-known in their fields, but for a work advertised as 'written for advanced undergraduates taking courses in mycology, applied biology, biotechnology, fungal biology and fungal genetics' I would have expected more explanatory introductory matter to ease such undergraduates into this arena. As is common with so many multi-authored volumes, the whole lacks the cohesion one might expect from a work under single or joint authorship. Should an undergraduate be contemplating a project or a postgraduate study in fungal phylogeny, for example, Berbee & Taylor's contribution is a most useful supplement to other general texts on molecular phylogenetics as applied to the fungi, and also a bridge to more specialized works such as that edited by Bridge *et al.* Discussed below. This will be a useful volume for a mycological department's library, but at such a price the main usage is likely to be by recommendation to particular chapters rather than encouraging students to buy personal copies.

Applications of PCR in Mycology. Edited by P. D. Bridge, D. K. Arora, C. A. Reddy & R. P. Elander. 1998. CAB International, Wallingford, Oxon OX10 8DE, UK. Pp. 15 + 357. ISBN 0 85199 233 1. Price: £60.00, $110.00 (USA).

The first book devoted entirely to PCR applications in mycology. With the methodology now featuring in so many aspects of mycology this is most timely. Further, many of the contributors are well-known active researchers in the field and based on their personal experiences. An introductory overview of the methodology is followed by chapters focusing on: gene cloning, screening for gene expression, species definition, use in lichen-forming fungi, mycorrhizal fungi, fungal phylogeny, entomopathogenic fungi, biotechnology, lignocellulose degradation, mycotoxin production, medical mycology, fungal-plant interactions, and seed-borne diseases. Future directions are also highlighted, including diagnostics, genome mapping and expression, and detection. This is a must for molecular mycologists, but for the systematist I would have liked to see more basic material included on the interpretation of sequence data, for example sequence alignment, secondary structure, and molecular trees.

Managing the Modern Herbarium. An interdisciplinary approach. Edited by Deborah A. Metsger & Sheila C. Byers. 1999. Society for the Preservation of Natural History Collections, Washington, DC. [Available through Elton-Wolf Publishing, Suite 212 - 1656 Duranleau Street, Granville Island, Vancouver, BC V6H 3S4, Canada.] Pp. xxii + 384. ISBN 0 9635476 2 3. Price: CAN $ 39.95 (US $ 29.95).

A multiauthored volume on herbarium management, arising from a project between The Society for the Preservation of Natural History Collections and the Royal Ontario Museum. A chanterelle dominates the front cover suggesting that they have a high profile in the book. In fact there are two specifically contributions amongst the 29 included: on destructive sampling of fungal specimens for molecular work (G. M. Mueller) and freeze-drying and storing entire fruit bodies of larger fungi (S. Moore). At first that might seem disappointing, and there are only passing mentions in others chapters. The importance of this book for the curators of dried mycological reference collections is the information that applies to dried collections of any kind: pest control, herbarium design, environmental control, paper type and conservation, adhesives, bar codes, record keeping, and especially recommendations agreed on destructive sampling for molecular work. A valuable adjunct to *The Herbarium Handbook* (L. Forman & D. Bridson, eds, Royal Botanic Gardens, Kew, 1989 and later editions) which has a more hands-on presentation and emphasises the practice at Kew.

ASCOMYCETES

Mycosphaerella* spp. and their Anamorphs associated with leaf Spot Diseases of *Eucalyptus. By Pedro W. Crous. 1998. APS Press, 3340 Pilot Knob Road, St Paul, Minnesota 55121-2097, USA. [Mycologia Memoir No. 21.] Pp. 170, 140 figs. ISBN 0 89054 190 6. Price: US $ 46.

This complex of fungi provides one of the largest challenges in the systematics of fungi of phytopathological importance at this time. In view of the scale of the problem, a host-oriented approach is a pragmatic approach. A remarkable 57 species are treated, including six new in *Mycosphaerella* (28 species in total), and further new species in the anamorph genera *Cercospora, Lecanostictopsis, Mycovellosiella, Passalora, Phaeoramularia, Pseudocercospora, Pseudocercopsorella,* and *Stigmina*. The new genus *Xenostigmina* is introduced for the fungus previously called *Stigmina zilleri* on *Acer*. The line drawings are first-rate, and both dichotomous and synoptic keys are provided. Practical guides of how to study and isolate these fungi are included. A major contribution to our knowledge of these fungi based on the author's long experience of this group.

LICHEN-FORMING FUNGI

Swedish Lichenology. Dedicated to Roland Moberg. Edited by Jan-Eric Mattsson, Mats Wedin & Inga Hedberg. 1999. Almqvist & Wiksell International, Stockholm, Sweden. [Symbolae Botanicae Upsalienses, No. 32(2).] Pp. 211. ISBN 91 554 4452 0, ISSN 0082-0644. Price not indicated.

A collection of eight papers prepared to mark the 60th birthday of Roland Moberg, Director of the Botanical Museum of the University of Uppsala since 1976, the leading international authority on the taxonomy of *Physcia* and related genera, and author or coeditor of several influential works on the identification and conservation of lichens in Sweden.

Unlike so many "Festschrift" works, this is not just a series of papers thrown together, but a collection with a focus on the history of lichenology. Sweden has always had a special place in lichenology since Acharius, the last pupil of Linnaeus to defend his thesis before Linnaeus, laid the foundations of many aspects of their study and described many common genera for the first time. P. M. Jørgensen covers Linnaeus and his pupils; L. Arvidsson lichenology in Sweden in the 19th century, and L. Tibell Swedish collections abroad. B. Johnsell and U.-M. Hultgård cover the development of Swedish herbaria over four centuries, and there are special features on the Uppsala School of Lichen Chemistry (J. A. Elix) and the writings of Gunnar Degelius (L. Ardvidsson & D. J. Galloway).

Of especial and wide interest is G. Rambold and D. Triebel's account of generic concepts in lichenized and lichenicolous fungi since 1950 - period in which 330 new generic names has been introduced in these groups. The period covers the integration of lichen-forming with other fungi, chemotaxonomy, the advent of scanning electron and transmission microscopy, new attention to ascus structure and ontogeny, and latterly molecular approaches. At the end of each section, there are worked synopses of pertinent examples arising from concepts then in vogue are provided. It is a salutary reminder that what is state of the art now may not been seen in quite the same light even 10-15 years on. This chapter should be compulsory reading for any ascomycetologist considering describing a new genus !

Understanding Lichens. By George Baron. December 1999. Richmond Publishing, P. O. Box 963, Slough SL2 3RS, UK. Pp. iv + 92, figs 49, col. plates 4. ISBN 0 85546 252 3. Price: £ 9.95.

Lichenology is desperately short of introductory texts on aspects such as nature, biology, ecology and uses to bridge the gap between identification manuals and more specialised works. George Baron, a former Professor of Educational Administration in the University of London, enthusiastically embraced lichenology as a hobby after he retired in 1978. He also wrote a regular column on lichens for naturalists in *British Wildlife* from 1990-97, and has now put his considerable educational skills even more into disseminating basic information about his chosen "pets". Published in conjunction with the independent South London Botanical Institute, the book ranges from chapters such as: What is a Lichen ?, Lichens and the Environment, and the Classification of Lichens, to the Uses of Lichens and The Amateur Study of Lichens. The chapter on Classification even includes three pages on the principles of nomenclature, but in stressing the modern integrative classification with other fungi a phylogenetic presentation of the place of lichen-forming families would have been a bonus.

In general the work is authoritative, and the photographs (including 24 in colour) are first-rate. However, some of the drawings would have benefited from the help of a professional artist, and the Literature on Lichenology section could have included some more recent reviews and multiauthored texts; these aspects merit attention in any future edition.

Although written primarily for a UK audience, the principles covered transcend national boundaries and the book can be expected to become widely used in field courses and by students embarking on sixth-form or undergraduate projects. With so much lichenological recording now being the provenance of the amateur, the need for such a book had become increasingly clear, and it is gratifying that Professor Baron has helped plug this hole in lichen literature.

Proceedings of the Symposium "Taxonomy, Evolution and Classification of Lichens and related Fungi, London 10-11 January 1998. Edited by M. Wedin, T. Tønsberg & D. H. Brown. 1998. Academic Press Ltd, 24-28 Oval Road, London NW1 7DX, UK. [Reprinted from The Lichenologist 30(4 & 5).] 209 pp. ISSN 0024-2829. Price not indicated.

A separately issued reprint of 15 papers presented at an international symposium sponsored by the British Lichen Society, Linnean Society of London, and Systematics Association. It is good to see these papers issued as a group in a refereed journal rather than as an independent book. Too much work is hidden in conference proceedings volumes that are difficult to locate or prohibitively expensive and I congratulate the editors on selecting this route. The focus is on molecular approaches, but controversial issues such as the naming of photobiont morphs, chemotypes, generic concepts in macrolichens, are also addressed. The field is rapidly developing, and although now a little old, there is much of lasting value here that all lichenologists will find of interest.

The Macrolichens in West Virginia. By Don G. Flenniken. 1999. Published by the author, 2273 Blachleyville Road, Wooster, Ohio 44691, USA. Pp. 231, 26 coloured plates. ISBN not indicated. Price not indicated.

A regional manual, the production of which was partly supported by grants from the West Virginia Division of Natural Resources. Keys and descriptions of all species are included, and maps showing occurrences on a county basis in the state. Particularly informative are notes on the ecology and status of the species which show that the author has a deep rapport with the macrolichens of the state. References to modern accounts and revisions are included where these exist. Especially valuable are the coloured plates covering some 275 species, and the results of microcrystal tests - something not used today as widely as they merit for those without access to thin-layer chromatographic facilities. The work includes a checklist, and a comparison of the current nomenclature with species reported in the last survey of lichens in the state by Sheldon in 1939, and also Hale's *How to Know the Lichens* (1979). It is great to see such a detailed work from a clearly most experienced and careful 'amateur' who has worked as a teacher and park naturalist. With current trends in North America, such detailed lichen recording and manuals are increasingly likely to rely on such dedicated persons.

BASIDIOMYCETES

Atlante fotografico dei Funghi d'Italia. Edited by Carlo Papetti, Giovanni Consiglio & Giampaola Simonini. Vol. 1. July 1999. Fondazione Centro Studi Micologici dell' Asociazione Micologica Bresadola, P. O. Box 296, 36100 Vicenza, Italy. Pp. cxviii + 512, numerous coloured plates. ISBN not indicated. Price not indicated.

Another splendidly illustrated field guide to Italian macromycetes. The comprehensive introduction includes a detailed account of characters used in identification, observations on ecology, and also keys to the genera. Each species has a page of its own, and this includes a detailed description and also drawings of spores - something sadly omitted in many field guides - and a note on edibility. The Association that prepared this book is well-known for the high quality of its work and this new title lives up their established reputation. A valuable addition to the growing number of European field guides.

CONIDIAL FUNGI

Illustrated Genera of Imperfect Fungi. By H. L. Barnett & Barry B. Hunter. 1998. Fourth edition.. APS Press, 3340 Pilot Knob Road, St Paul, Minnesota 55121-2097, USA. Pp. xxii + 218. Spiral bound. ISBN 0 89054 192 2. Price: US $ 43.

A new edition of this familiar work. The Saccardoan classification is still followed, although it is recognized in the Introduction that the orders and families used are not phylogenetic but 'only to facilitate their identification'. Innovations for this edition include a general introduction, a simplified key to some commonly isolated genera, and a series of fine scanning electron micrographs illustrating conidiogenesis types according to the Hughesian system. No updating according to the Hennebert & Sutton coding system was attempted and certainly should be considered for any future edition. Surprisingly 52 genera 'infrequently isolated and of little economic importance have been omitted'. Some taxonomy would have benefited from updating (e.g. *Cephalosporium* is still accepted and there is no reference to *Acremonium*). An indication of the species numbers in the treated genera would also have been helpful. Especially welcome is a series of 15 experiments to illustrate various biological aspects of these fungi which will be of value to those wishing to extend their use in practical classes. A downside of trying to illustrate so many genera is the small size of the drawings; those in Ellis & Ellis' *Microfungi on Land Plants* (1985; not cited in the Bibliography) show what can be achieved in this regard. In summary, a work to be used with caution until a more through revision is available.

YEASTS AND YEAST-LIKE FUNGI

Ecology and Evolution of Black Yeasts and their Relatives. Edited by G. S. De Hoog. 31 May 1999. [Studies in Mycology No. 43.] Centraalbureau voor Schimmelcultures, Baarn, P. O. Box 273, NL-3740 AG Baarn, The Netherlands. Pp. 208. ISBN 90 70351 39 0; ISSN 0166-0616. Price: Eu 48.00.

What are the black yeasts? If you have ever pondered this question, you definitely need to buy this book. The book itself is a compilation of 21 papers (17 research papers, 3 short communications and 1 review). The *Studies in Mycology* series has entered a new era with a much friendlier A4 format, and an excellent reproduction of line drawings, as well as half-tone and colour photographic plates, printed on good quality paper. One of the primary aims of this book has undoubtedly been to establish a solid molecular base for this pleomorphic group of fungi. Of the papers that are presented, wide ranging issues such as evolution, ecology, taxonomy and phylogeny are addressed. Nearly all the acknowledged researchers in the field have participated in some or other aspect of this book. I found all the papers well-illustrated, and also incorporating a variety of techniques to address specific, well-defined questions. Several of the chapters will be of interest to a wider mycological and plant pathological audience other than those focused on the black yeasts *per se*. I found the chapters dealing with the dothideaceous black yeasts of particular interest. Many epilithic and halotolerant black yeasts are related to the *Dothideales*, including *Aurobasidium*, *Discosphaeria*, *Hormonema,* etc., that are able to convert to meristematic growth under stress. I found the choice of isolates relevant and the eventual phylogenies presented extremely exciting. For instance, *Trimmatostroma* clustered close to *Cladosporium* and *Stenella*, which suggests that it could have a *Mycosphaerella*-like teleomorph. A cultural link has recently been proven for *Trimmatostroma* in *Teratosphaeria*. What then is the relationship of the latter genus to *Mycosphaerella*? Strains of *Stenella araguata* (from human and plant hosts) also clustered separately, once again questioning if *Stenella* should be used to accommodate human pathogens. This is also somewhat reminiscent of the *Cladophialophora*/*Pseudocladosporium* situation, where saprophytic strains from plant material cluster in the latter. Several chapters are dedicated to resolving species complexes within *Cladophialophora*. A significant body of information is presented on species of *Trimmatostroma* throughout this book, and it appears that the *Trimmatostroma*-like morphology has evolved more than once, and that several anamorph genera may have to be introduced to suitably characterize this variation. *Aurobasidium*, *Kabatiella* and *Hormonema* are also related to the *Dothideales*. Most of us know these genera as endophytes that usually turn up on diverse hosts, and sometimes, as in the case of *Kabatiella*, as pathogens. Results of some of the work presented here support the separation of *Kabatiella* (plant pathogen) from *Aurobasidium* (saprophyte), which will make sense to most phytomycologists that have dealt with these organisms. *Kabatiella zeae* clustered outside the *Aurobasidium*/*Hormonema* complex, and could possibly belong to the *Pleosporales*, suggesting that the nomenclature of this pathogen needs to be revised. I also found the chapter by De Hoog *et al.* dealing with the taxonomy of the *Phialophora verrucosa* complex of interest. The name *Phialophora* (*Herpotrichiellaceae*; teleomorph *Capronia*) has been applied to a diversity of pigmented fungi with aseptate, slimy conidia borne on phialides with clearly defined cup-shaped collarettes. Research on this group has led to the identification of several generic entities such as *Phialomonium*, *Phaeoacremonium* and *Phaeomoniella* to name but a few. Of particular interest is the differentiation of collarette types in *Phialophora*, which should provide a valuable additional morphological criterion. Related genera such as *Exophiala* are also shown to be polyphyletic, though those with annellidic proliferation of conidiogenous cells were shown to be monophyletic. In summary, many species are newly described or redisposed to other genera based on a wealth of newly generated sequence data. I would, however, have liked to have the accession numbers clearly indicated in the respective chapters to all these novel sequences. Although I could find this information for most, it was definitely not present for all the data presented. A general index for those of us who quickly want to locate data on a specific fungus or technique would also have made this book much more user friendly. That said, however, I can still easily recommend this book based on the quality of the work, and the bulk of novel information presented. *PEDRO W. CROUS, University of Stellenbosch, Matieland, South Africa*

SLIME MOULDS

The Myxomycetes of Britain and Ireland. An identification handbook. By Bruce Ing. September 1999. Richmond Publishing, P. O. Box 963, Slough SL2 3RS, UK. Pp. iii + 374, figs 357. ISBN 0 85546 251 5. Price: £ 35 (+ postage and packing £ 3).

This book is the distillation of some four decades of experience of the identification and ecology of myxomycetes in Great Britain and Ireland by one of the world's leading authorities on the group. Aspects covered in the introductory chapters cover phylogeny, life-histories, ecology, distribution, collection, culture, and preservation. Keys to orders and families are followed by systematically arranged accounts, with keys to genera and species. Each species account includes a references to the place of publication of the name, description, references to illustrations in other works, information on the habitat and distribution inside the British Isles and world-wide, and generally extremely helpful and often perceptive 'notes'. Line-drawings of the species are provided, emphasizing diagnostic features. An appendix gives the derivation of names, and there is also a glossary, annotated bibliography, and list of useful addresses. As so many myxomycetes are widely distributed, this will be a 'must' for the myxomycologist's wants list.

MISCELLANEOUS

A Beginner's Guide to Secondhand Bookdealing. By Stuart A. Baldwin. September 1999. Baldwin's Scientific Books, Fossil Hall, Boars Tye Road, Silver End, Witham, Essex CM8 3QA, UK. Pp. ix + 214, 5 pl., 2 figs. ISBN 0 9508063 5 8. Price: £ 24.

As a result of delving into the history of names, taxonomists inevitably develop an interest if not a passion for long out of print or antiquarian texts; mycologists are no exception to this general rule. This means becoming a purchaser and often a vendor of such works. But how does the mysterious world of second-hand bookselling operate ? What do all the often abbreviated terms in booksellers' catalogues mean ? How are books priced ? What if books are stamped or written on ? Here a successful natural history bookseller specialising in palaeontology and evolutionary topics, and who also has had experience in establishing new businesses for the London Enterprise Agency opens Pandora's box. The style is light-hearted in part, but includes much background information that a mycologist, finding he or she was moving into this area, even if not planning to start a business, could profit from.

Sustainable Use of Genetic Resources under the Convention on Biological Diversity.. By W. H. Lesser. 1998. CAB International, Wallingford, Oxon OX10 8DE, UK. Pp. 240. ISBN 0 85199 197 1. Price: £ 35.00, US $ 65.00.

How to manage the collection and transfer of specimens and cultures of fungi in the post-Convention environment period is a matter of increasing concern to mycologists. Although not focusing on microbiological issues, this book covers legal and economic issues. Especially relevant are summaries of the laws and other regulations in place in particular countries. This will not provide all the answers to every situation, but will give a better understanding of the issues and ways of complying with them.

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Effective 14 February 2000, subscribers to Mycotaxon are now offered a $20.00 reduction in the price of S. C. Teng‘s Fungi of China, acclaimed by reviewers as “an instant classic” and as “one of the most valuable books on the fungi of China ever published in English.” It will be shipped to current subscribers at a price of $59.00 postpaid (by surface mail), except for delivery to Canada, where the price for surface delivery is $64.00. Airmail delivery differs by country; please ask for the airmail price to your country. The dimensions of this hardcover book are 8-1/2 x 11 inches; it has 600 pages, 426 illustrations, and it weighs over 4 pounds.

The reduced price is possible through the generosity of Rosaline Deng, Teng's daughter, who not only translated the original text from English to Chinese but also contributed the foreword to the English version of Teng's book, finally published by Mycotaxon, Ltd. in 1996. Subscribers are free to purchase several copies at this reduced price, and are free to give such copies to their institutional libraries or friends. Ms. Deng does this as a token of appreciation to Mycotaxon, Ltd. for its assistance in publishing the book, and to offer the supporters of the journal, its subscribers, an opportunity to purchase the book at a very reasonable price. You can find out more about the book by visiting our website, <www.mycotaxon.com/books.html>. To order one or more copies, please either (i) write to Mycotaxon, Ltd., Order Department, P. O. Box 264, Ithaca, NY 14851-0264 or, perhaps much easier, (ii) just visit our website at <www.mycotaxon.com/order.html>. There you can either arrange to have an e-mail order form sent to you, or you can download an order form for mailing or faxing your order. Another possibility is (iii) to send an e-mail message to the Order Department at <rkorf@att.net> asking for a books order form to be sent to you by e-mail.

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The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

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Publication Date for Volume Seventy-Four, No. 1

MYCOTAXON for January-March, volume 73(1): 1-256
was issued on March 10, 2000.

MYCOTAXON is published quarterly during the periods of January–March, April–June, July–September, and October–December by Mycotaxon, Ltd., 316 Richard Pl., Ithaca, NY 14850–0264. Periodical postage paid at Ithaca, NY, and at additional mailing offices. Subscription rates (year 2000 only): In U. S. and possessions, one year, $201.00; reduced rate for personal subscribers, one year, $96.00. Foreign subscriptions, add $6 for surface mail, or add $30 for ISAL air mail.

POSTMASTER: Send address changes to Mycotaxon, Ltd., P.O. Box 264, Ithaca, NY 14851-0264.

MYCOTAXON

AN INTERNATIONAL JOURNAL OF RESEARCH ON
TAXONOMY & NOMENCLATURE OF FUNGI, INCLUDING LICHENS

VOLUME LXXIV, 2000

COMPLETE IN TWO QUARTERKY ISSUES
CONSISTING OF iv + 546 PAGES INCLUDING FIGURES

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ITHACA, NY 14851-0264, USA

www.mycotaxon.com

Printed in the United States of America

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